Allen-Bradley

ControlLogix Hydraulic Servo Module

1756-HYD02

User Manual

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of these products must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards. In no event will Rockwell Automation be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

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WARNING

Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

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Using This Manual

This preface describes how to use this manual.

Who Should Use This Manual

To effectively use this manual, you should be able to program and operate the Rockwell Automation ControlLogix™ controllers to efficiently use your ControlLogix Hydraulic Servo module. In this manual, we also refer to the module as the 1756-HYD02 module.

If you need more information about programming and operating the ControlLogix controllers, refer to the *Logix5000™ Controller User Manual*, publication number 1756-UM001.

The Purpose of This Manual

This manual describes how to set up, configure and troubleshoot your 1756-HYD02 module.

Table Preface.1 lists describes each section in this manual:

Table Preface.1

If you are looking for this information:	See this section
Description of the module and what it does.	Chapter 1 What is the 1756-HYD02 Module?
Step by step description of how to install and wire the module.	Chapter 2 Installing the 1756-HYD02 Module
Description of how to use RSLogix™ 5000 programming software to configure the module.	Chapter 3 Configuring the 1756-HYD02 Module
Complete listing of the module's features, including the general module features and features that specifically affect the data coming from axes connected to either of the module's channels.	Chapter 4 Using the 1756-HYD02 Module Features
Description of how to troubleshoot any problems with the module, including the use of status indicators on the module and software fault messages in RSLogix 5000.	Chapter 5 Troubleshooting the 1756-HYD02 Module
Specifications for the module.	Appendix A Specifications

Related Documentation

The following table lists related ControlLogix documentation:

Table Preface.2

Publication Number	Publication	Description
1756-IN580	*ControlLogix Hydraulic Servo Module Installation Instructions*	Provides instructions for installing, wiring, and troubleshooting your 1756-HYD02 module.
1756-IN080	*ControlLogix Chassis Installation Instructions*	Provides instructions for installing a ControlLogix chassis
1756-5.78	*ControlLogix Power Supply Installation Instructions*	Provides instructions for installing a ControlLogix power supply
1756-IN573	*ControlLogix Redundant Power Supply Installation Instructions*	Provides instructions for installing a ControlLogix redundant power supply
1756-IN574	*ControlLogix Redundant Power Supply Chassis Adapter Module Installation Instructions*	Provides instructions for installing a ControlLogix redundant power supply chassis adapter module
1756-UM001	*Logix5000 Controller User Manual*	Provides information for using your Logix5000 controller and its components.
1756-RM003	*Logix5000 Controller Instruction Set Reference Manual*	Provides descriptions of all the instructions supported by the RSLogix 5000 programming software.

To view or order the publications listed in Table Preface.2, visit:

www.theautomationbookstore.com

www.ab.com/manuals

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What is the 1756-HYD02 Module?

This chapter describes the ControlLogix Hydraulic Servo module.

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What the Module Does

THe 1756-HYD02 module is typically used for accurate positioning and control of a hydraulic cylinder. The module can be wired to a linear displacement transducer (LDT) for feedback and a proportional or servo valve for control of a hydraulic axis and connects to a hydraulic system to close a high-speed position loop. Each Logix controller can support up to 16 1756-HYD02 modules. Each 1756-HYD02 module can control up to two axes.

The 1756-HYD02 module monitors the position feedback via the linear displacement transducer (LDT) input and generates an analog command reference for the valve to make sure that the actuator (cylinder) follows the profile. The 1756-HYD02 module closes the position loop at a programmed rate using position feedback as the input and produces a +/-10V analog output velocity command.

The module is programmed with motion instructions in the RSLogix 5000 programming software and must be in the same chassis as the ControlLogix controller that controls the module. If you distribute motion control that uses the 1756-HYD02 module across different locations, place a ControlLogix controller in each chassis that has a 1756-HYD02 module. In this case, use a 1756-SYNCH module to synchronize motion between the multiple chassis.

Transducers connected to the 1756-HYD02 must accept external interrogation signals. In this case, the transducer generates its position information each time that it receives an interrogation pulse. Do not use transducers configured for internal interrogation because they will not be properly synchronized to the module.

Using A ControlLogix Hydraulic Servo Module in the ControlLogix System

A ControlLogix Hydraulic Servo module mounts in a ControlLogix chassis and uses a removable terminal block (RTB) or interface module (IFM) to connect all field-side wiring.

Before you install and use your module you should have already:

- installed and grounded a ControlLogix chassis and power supply. To install these products, refer to the publications listed in Table Preface.2 on page Preface-2.
- ordered and received an RTB or IFM and its components for your application.

IMPORTANT RTBs and IFMs are not included with your module purchase. You must order them separately. For more information, contact your local distributor or Rockwell Automation representative.

Physical Features of the ControlLogix Hydraulic Servo Module

Figure 1.1

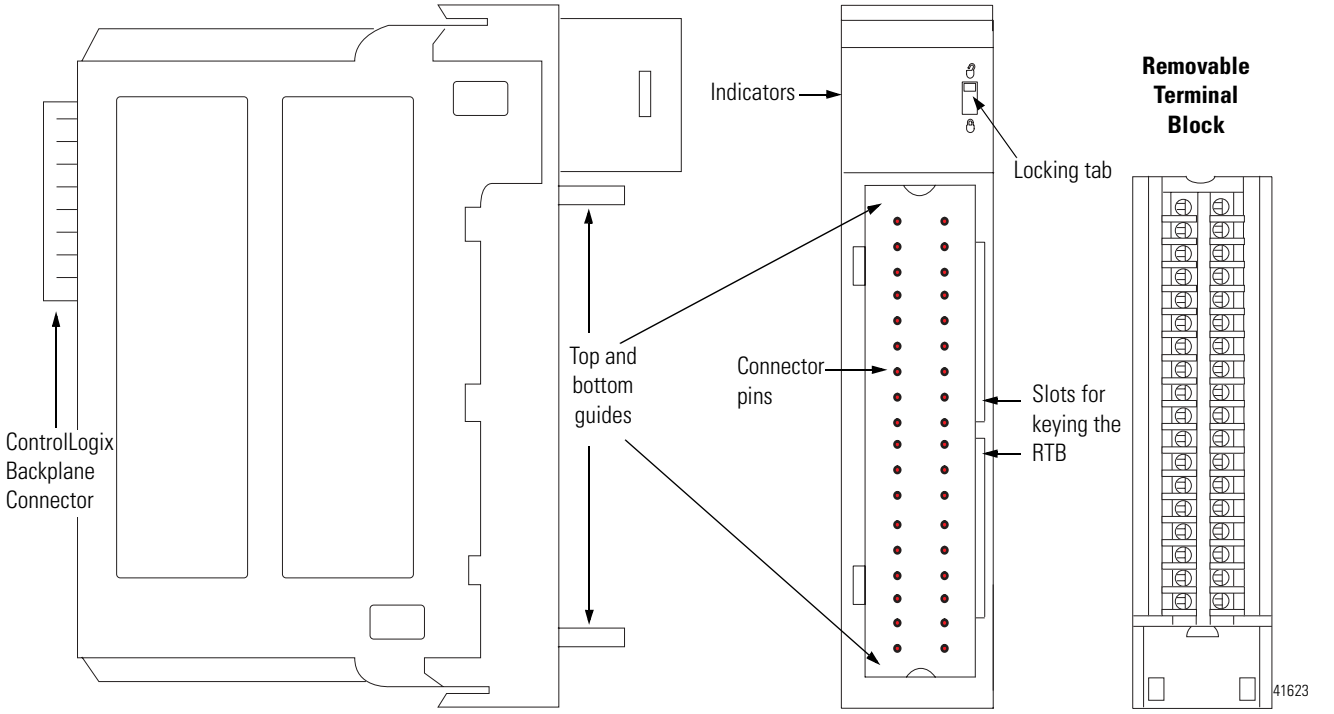

Table 1.1 lists the physical features on the ControlLogix Hydraulic Servo module.

Table 1.1
ControlLogix Hydraulic Servo Module Physical Features

Feature:	Description:
ControlLogix backplane connector	The interface to the ControlLogix system; it connects the module to the backplane.
Connectors pins	Input/output and grounding connections are made to the module through these pins with the use of an RTB.
Locking tab	The locking tab anchors the RTB on the module, maintaining wiring connections.
Slots for keying	Slots mechanically key the RTB to prevent you from making the wrong wire connections to your module.
Status indicators	Indicators display the status of communication, module health and presence of input/output devices. Use these indicators to help in troubleshooting.
Top and bottom guides	Guides provide assistance in seating the RTB onto the module.

Certifying Agency Approvals

If the ControlLogix Hydraulic Servo module has obtained any agency approvals (e.g. CE/CSA/UL), the module label is marked as such.

Full Class I Division 2 Compliance

The ControlLogix Hydraulic Servo module maintains CSA Class I Division 2 system certification. The module can be placed in an environment other than only 100% hazard free.

IMPORTANT The 1756-HYD02 module should not be pulled under power, nor should a powered RTB be removed, in a Class I Division 2 environment.

Preventing Electrostatic Discharge

The 1756-HYD02 module is sensitive to electrostatic discharge.

ATTENTION

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- If available, use a static-safe workstation.
- When not in use, store the equipment in appropriate static-safe packaging.

Removal and Insertion Under Power

You can install or remove the module while chassis power is applied if you observe the following precautions.

WARNING

When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

However, as stated on the previous page, the 1756-HYD02 module should not be pulled under power, nor should a powered RTB be removed, in a Class I Division 2 environment.

Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.

We do not recommend removing and inserting the 1756-HYD02 module while under power if the servo loop is closed. Make sure the servo loop is open (i.e. flashing green feedback indicator) before removing or inserting the module under power.

Chapter Summary and What's Next

In this chapter, you read a description of the 1756-HYD02 module. Chapter 2 describes Installing the 1756-HYD02 Module.

Installing the 1756-HYD02 Module

What This Chapter Contains

This chapter describes how to install the 1756-HYD02 module.

For information about:	See page:
Installing the Module	2-2
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Connecting Wiring	2-4
Assembling The Removable Terminal Block and the Housing	2-11
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The 1756-HYD02 module mounts in a ControlLogix chassis and uses a removable terminal block (RTB) to connect all field-side wiring.

Before you install your module, make sure you:

- install and ground a ControlLogix chassis and power supply.
- order and receive an RTB, and its components, for your application.

For more information on all the ControlLogix chassis and power supplies, see the ControlLogix Selection Guide, publication 1756-SG001.

Note the Power Requirements

This module receives power from the 1756 chassis power supply and requires two sources of power from the backplane:

- 700mA at 5.1V
- 2.5 mA at 24V

Add this current to the requirements of all other modules in this chassis to prevent overloading the backplane power supply.

Installing the Module

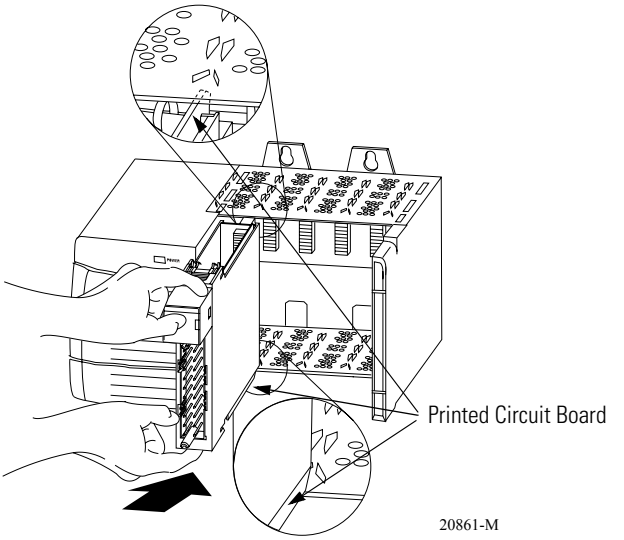
You can install or remove the module while chassis power is applied.

ATTENTION

The module is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature.

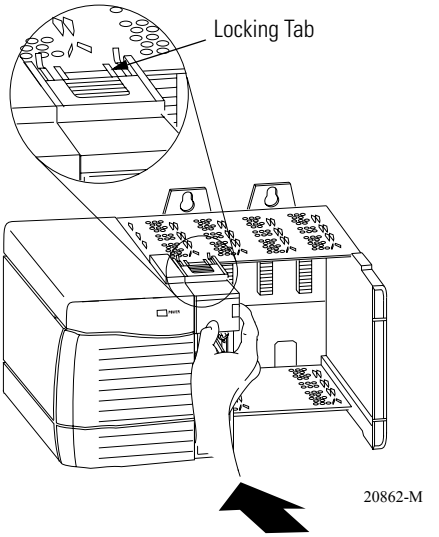
1. Align circuit board with top and bottom chassis guides.

Figure 2.1



2. Slide module into chassis until module tabs 'click'.

Figure 2.2



Keying the Removable Terminal Block

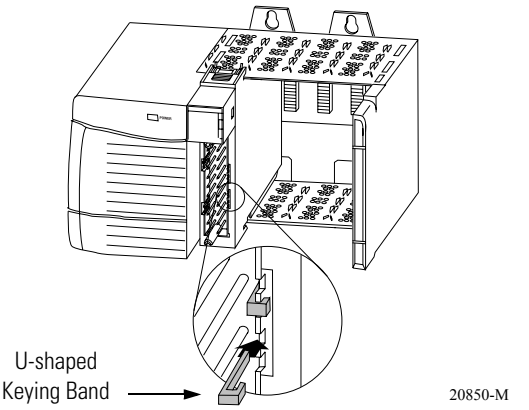
Key the RTB to prevent inadvertently connecting the incorrect RTB to your module. When the RTB mounts onto the module, keyed positions match up. For example, if you place a U-shaped keying band in position #4 on the module, you cannot place a wedge-shaped tab in #4 on the RTB or your RTB will not mount on the module.

Use a unique keying pattern for each slot in the chassis.

1. Insert the U-shaped band with the long side near the terminals.

2. Push the band onto the module until it snaps in place.

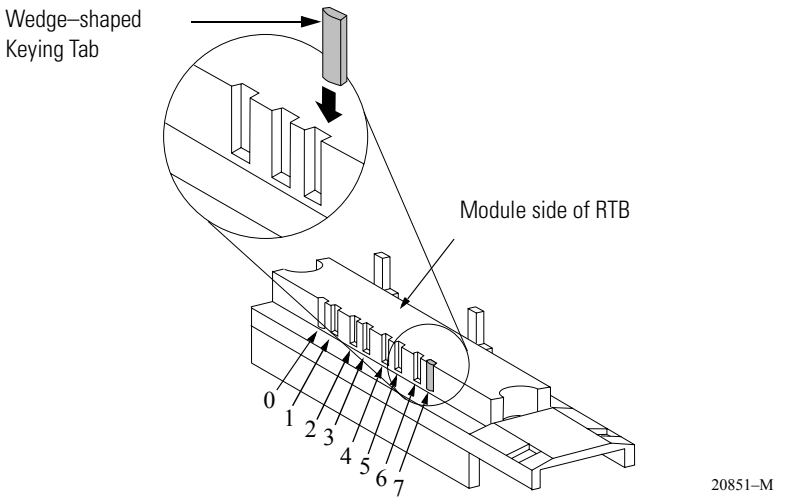
Figure 2.3



3. Key the RTB in positions that correspond to unkeyed module positions. Insert the wedge-shaped tab on the RTB with the rounded edge first. Push the tab onto the RTB until it stops.

IMPORTANT When keying your RTB and module, you must begin with a wedge-shaped tab in position #6 or #7.

Figure 2.4



Connecting Wiring

This module uses an RTB or a Bulletin 1492 Interface Module (IFM)[1] to connect all field-side wiring. Use an extended-depth cover (1756-TBE) for applications with heavy gauge wiring or requiring additional routing space. The maximum wire gauge that can be used with the 1756-HYD02 module is #14 AWG (2.08 sq. mm) stranded.

If you are using an RTB to connect wiring to you module, follow the directions beginning below.

An IFM has been prewired before you received it. If you are using an IFM to connect wiring to the module, consult the documentation that came with it to connect wiring, skip this section and move to page 2-11.

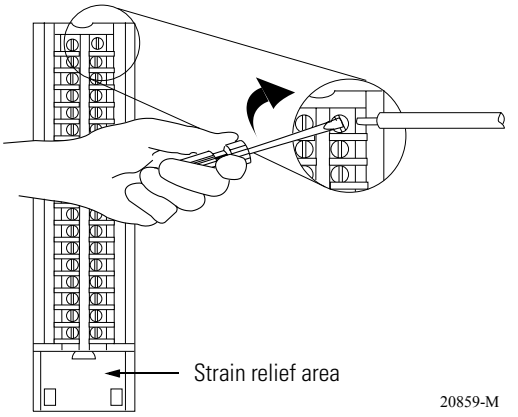
Two Types of RTBs (each RTB comes with housing)

- Cage Clamp - Catalog number 1756-TBCH
- Spring Clamp - Catalog number 1756-TBSH or TBS6H

Cage Clamp

1. Insert the wire into the terminal.
2. Turn the screw clockwise to close the terminal on the wire.

Figure 2.5

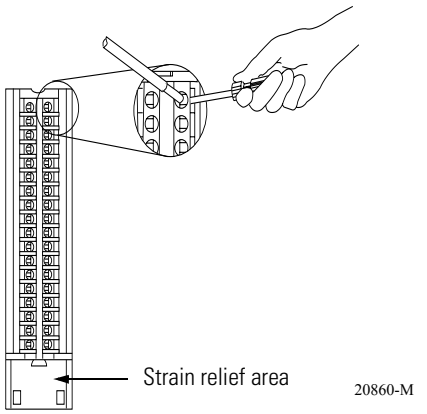


[1] The Bulletin 1492 IFM may not be used in any application that requires agency certification of the ControlLogix system. Use of the IFM violates the UL, CSA and FM certifications of this product.

Spring Clamp

1. Insert the screwdriver into the outer hole of the RTB.
2. Insert the wire into the open terminal and remove the screwdriver.

Figure 2.6



Recommendations for Wiring Your RTB

TIP

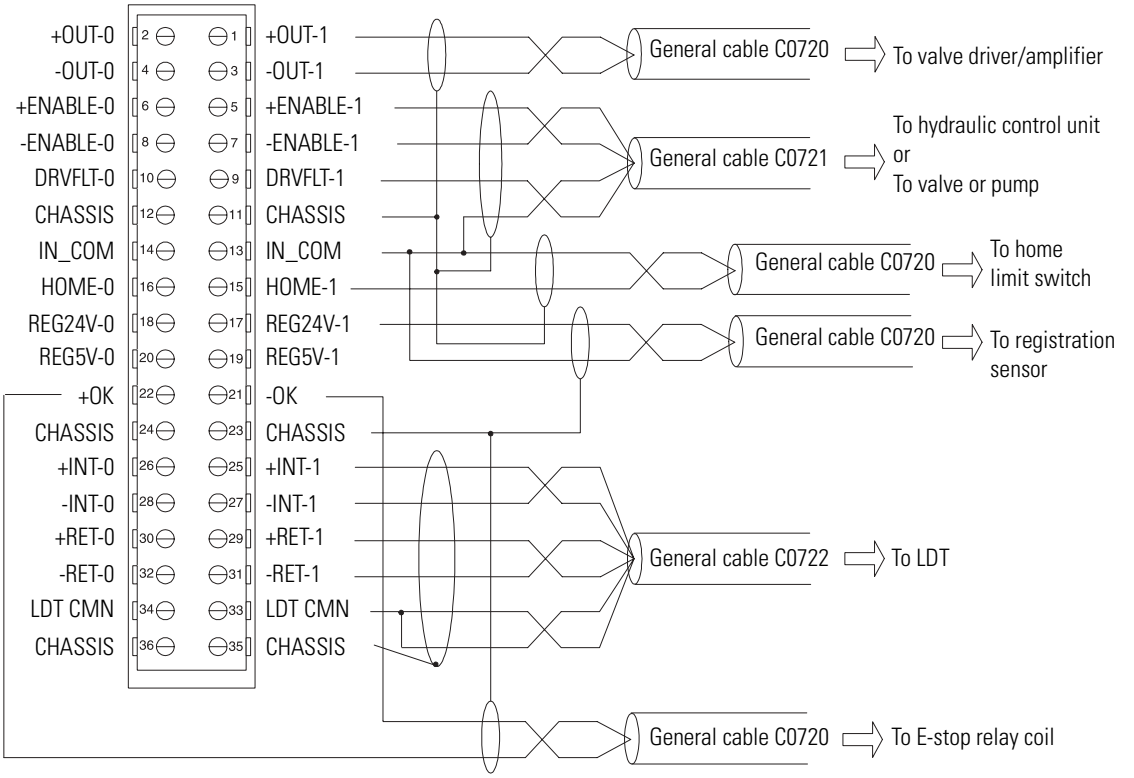
Consider the following when wiring your RTB:

- Begin wiring the RTB at the bottom terminals and move up.
- Use a tie to secure the wires in the strain relief area of the RTB.
- The **jumper bar** part number is 97739201. Contact your local Rockwell Automation sales representative to order additional jumper bars, if necessary.
- Order and use an **extended-depth housing** (Cat. No.1756-TBE) for applications that require heavy gauge wiring. For more information, see page 2-12.

Wiring the 1756-HYD02 Module

Use the wiring example in Figure 2.7 to wire to your module.

Figure 2.7



NOTES:

1. This is a general wiring example illustrating Axis 1 wiring only. Other configurations are possible with Axis wiring identical to Axis 1.
2. Make sure that any transducer connected to the 1756-HYD02 module uses an external interrogation signal.
3. Do not exceed the specified isolation voltage between power sources.

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Wiring Registration Sensors

The registration inputs to the servo module can support 24V or 5V registration sensors. These inputs should be wired to receive source current from the sensor. Current sinking sensor configurations are not allowed because the registration input common (IN_ COM) is shared with the other 24V servo module inputs.

Figure 2.8 - 24V Registration Sensor

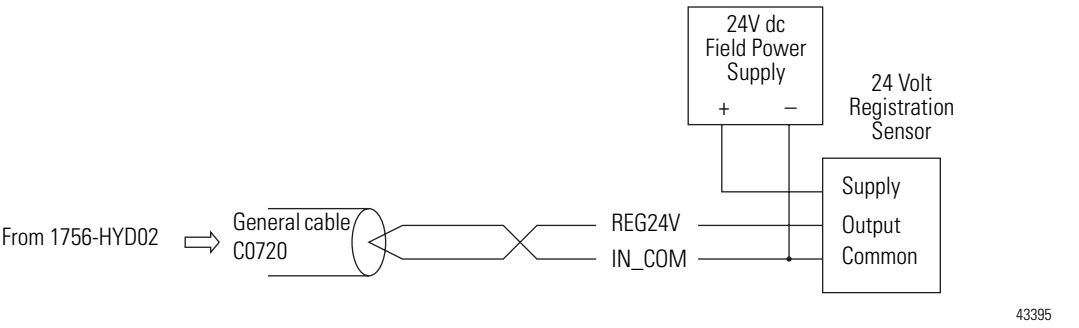
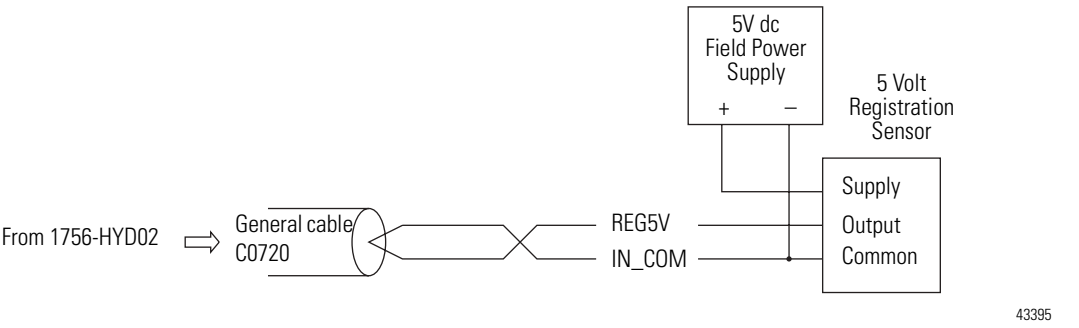


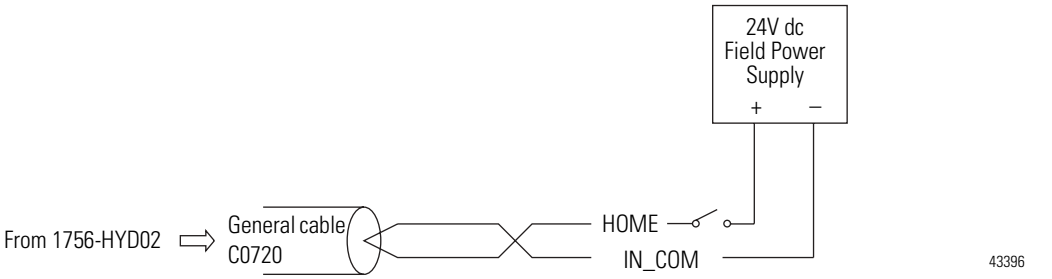
Figure 2.9 - 5V Registration Sensor



Wiring the Home Limit Switch Input

The home limit switch inputs to the servo module are designed for 24V nominal operation. These inputs should be wired for current sourcing operation.

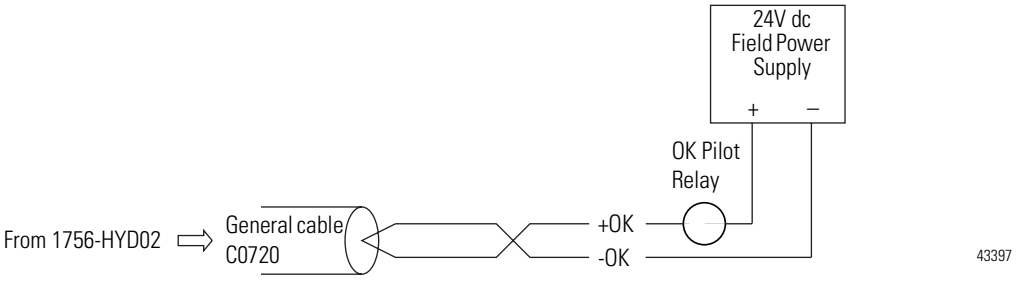
Figure 2.10

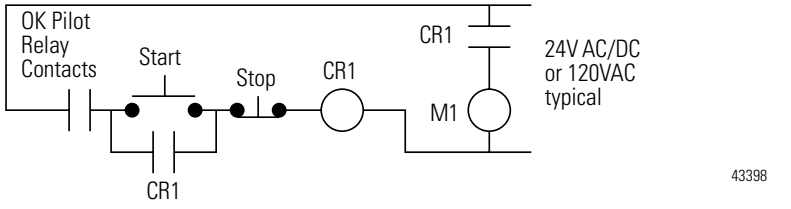


Wiring the OK Contacts

A set of isolated solid- state OK relay contacts is provided for optional interface to an E- stop string, which controls power to the associated pumps. The OK contacts are rated to drive an external 24V pilot relay (for example, Allen-Bradley 700-HA32Z24) whose contacts can be incorporated into the E-Stop string as in Figure 2.11.

Figure 2.11





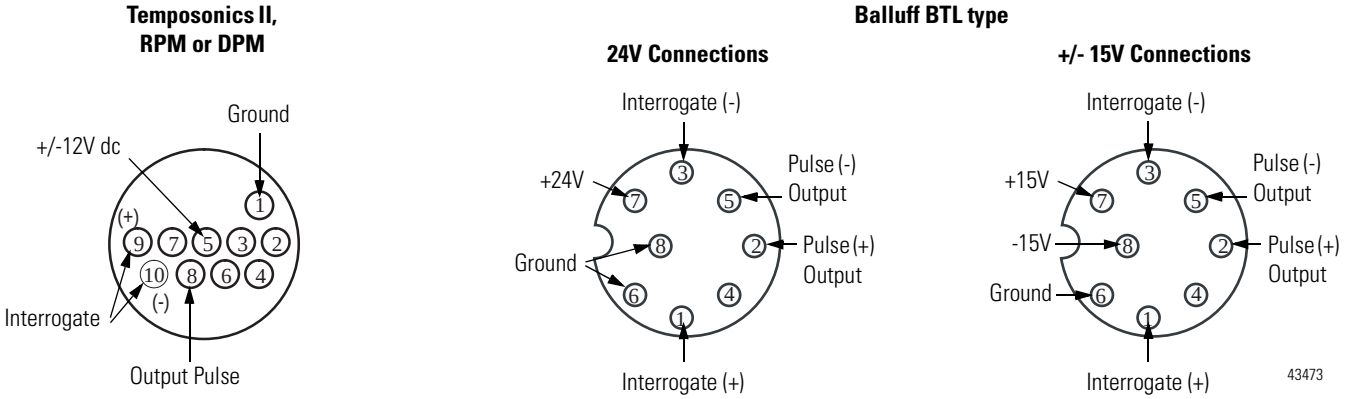
Connecting LDTs to Your Hydraulic Module

Because the number of LDTs that you can connect to your 1756-HYD02 module is continually changing, we cannot list all the available LDTs here. Figure 2.12 shows the connections for two example LDT types–Temposonic and Balluff–that were available for connection to the 1756-HYD02 module at the time of this printing.

IMPORTANT Remember, there are other suppliers with compatible LDTs. Before connecting an LDT to your module, we recommend you make sure it is the best available LDT for your application.

Also, when wiring an LDT to your module, always follow the LDT manufacturer's instructions on making connections.

Figure 2.12



No shield connections on these examples

Table 2.1 lists the LDT connections.

Table 2.1 LDT Connections for Fabricating Your Own LDT Cable

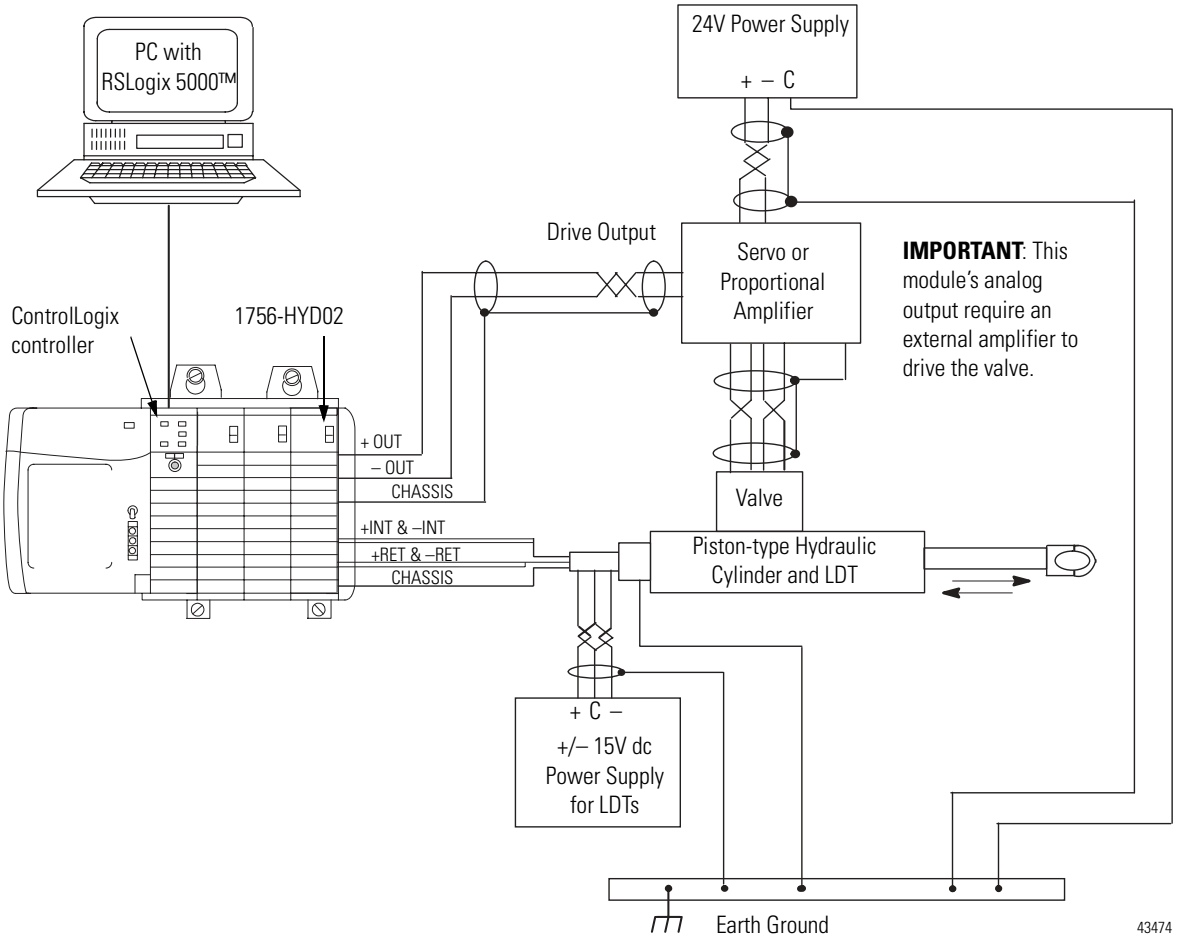
Function[1]	1756-HYD02 RTB Wiring (Numbers below represent terminal numbers)		Temposonics II[2] RPM or DPM	Balluff BTL type	
	Channel 0	Channel 1		24V dc	+/- 15V dc
(+) Interrogate	26	25	9 - Yellow	1 - Yellow	1 - Yellow
(-) Interrogate	28	27	10 - Green	3 - Pink	3 - Pink
Power Supply	N/A		5 - Red (+/-12V)	7 - Brown (+24V)	7 - Brown (+15V) 8 - White (-15V)
Ground	34	33	1 - White	6 - Blue 8 - White	6 - Blue
Output Pulse	30 (+) 32 (-)	29 (+) 31 (-)	8 - Purple	2 - Gray (+) 5 - Green (-)	2 - Gray (+) 5 - Green (-)

(1) (+) and (-) wires of the same function should be a twisted pair within the cable.

(2) Do not connect to pins 2, 3, 4, 6 or 7

Figure 2.13 shows an application wiring example using a 1-axis loop with a differential LDT input. (The power supplies and servo amplifiers are user-supplied.)

Figure 2.13

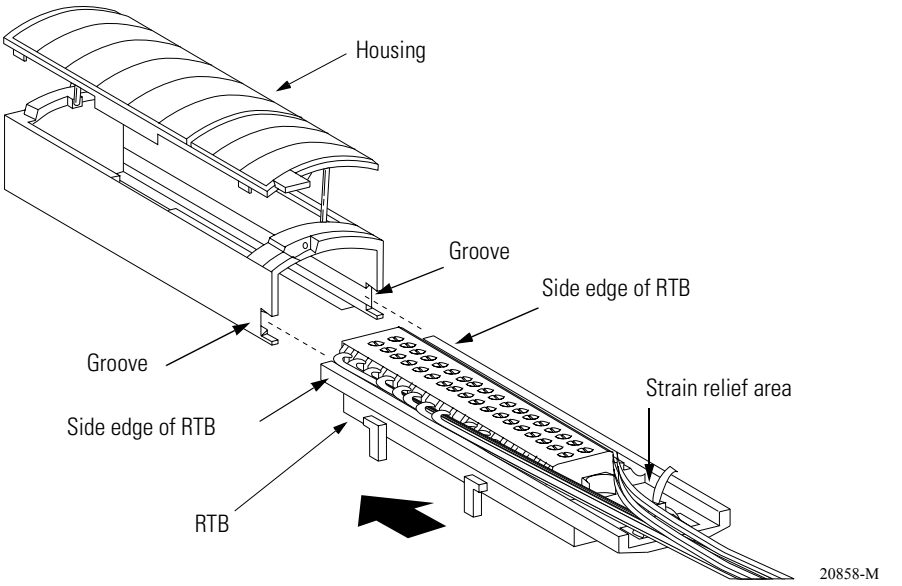


Assembling The Removable Terminal Block and the Housing

Removable housing covers the wired RTB to protect wiring connections when the RTB is seated on the module.

1. Align the grooves at the bottom of each side of the housing with the side edges of the RTB.

Figure 2.14



2. Slide the RTB into the housing until it snaps into place.

IMPORTANT If additional wire routing space is required for your application, use extended-depth housing 1756-TBE.

Choosing the Extended-Depth Housing

There are two housing options you must consider when wiring your ControlLogix Hydraulic Servo module. When you order an RTB for your I/O module, you receive a standard-depth housing with the RTB. If your application uses heavy gauge wiring, you can order an extended-depth housing. This housing does not come with an RTB.

You can use one of the housings listed in Table 2.2:

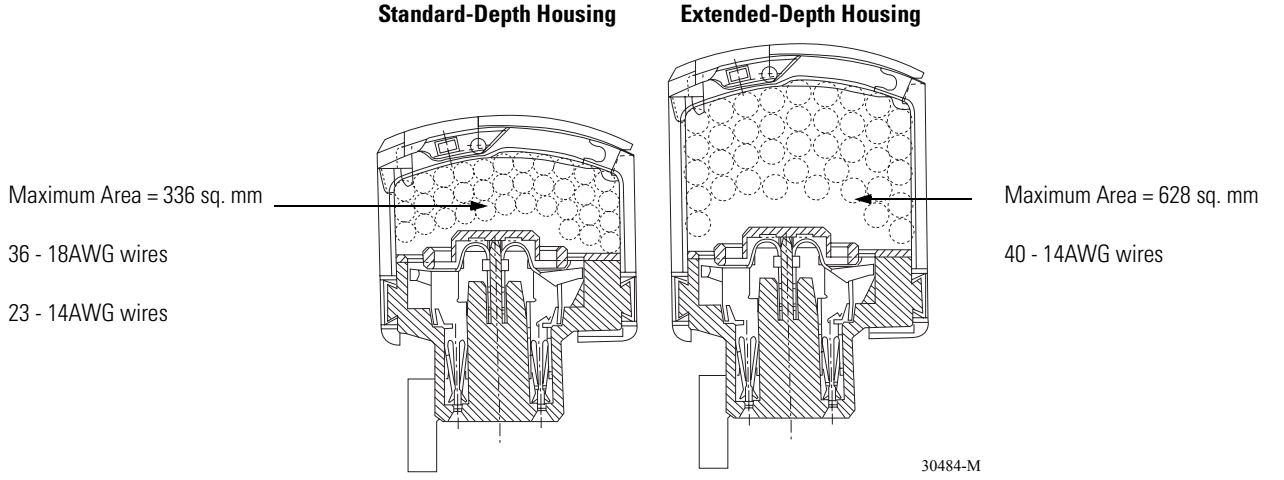
Table 2.2

This housing:	should be used with this RTB:	and allows up to this capacity of wires:
1756-TBCH	Cage clamp	336 sq. mm
1756-TBS6H	Spring clamp	
1756-TBE	Any RTB using heavy gauge wiring	628 sq. mm

Figure 2.15 shows the difference, in terms of capacity, between the housing options.

IMPORTANT The housings shown are used with a spring clamp RTB, but the capacity for each remains the same regardless of RTB type.

Figure 2.15



IMPORTANT The housings use the following maximum areas:

- standard-depth housing maximum area = 336 sq. mm
- extended-depth housing maximum area = 628 sq. mm

Suggestions for Using the Extended-Depth Housing

TIP

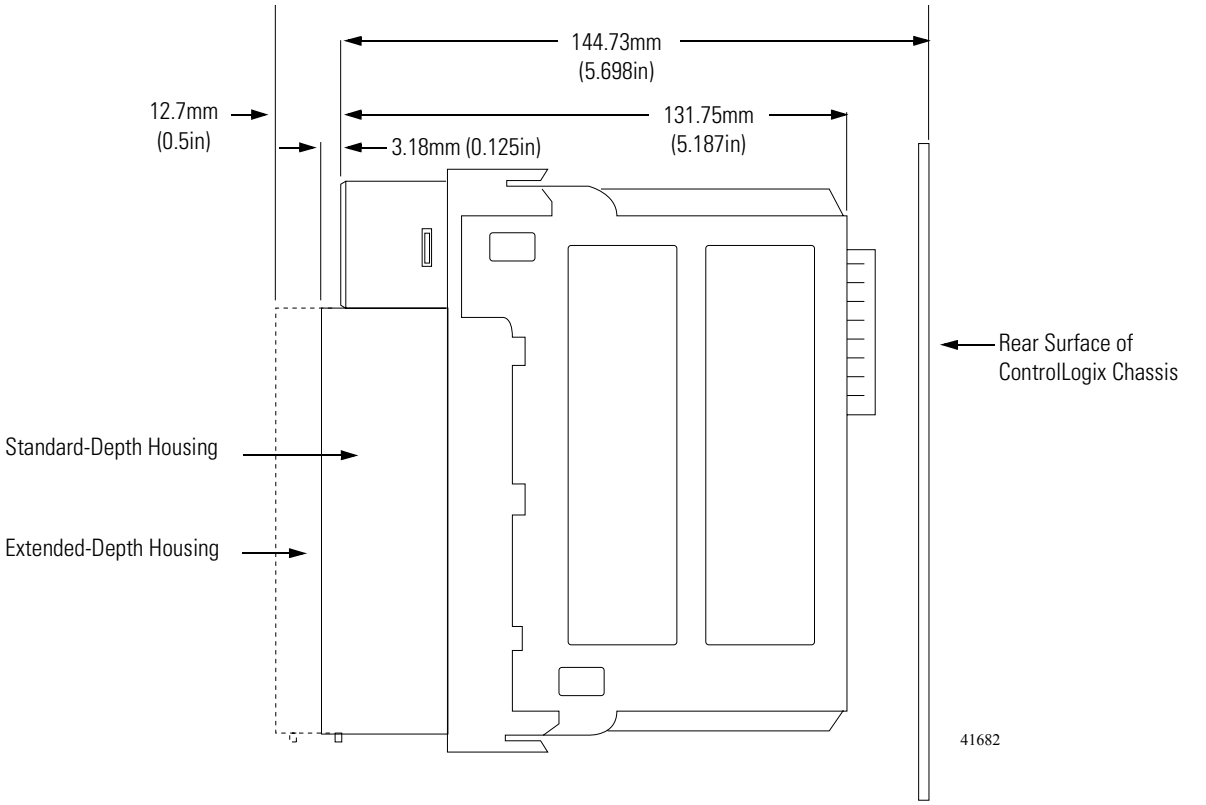
Consider the following when deciding to use an extended-depth housing on your I/O module. It is recommended you use the 1756-TBE when:

- using >36 18AWG wires
- using >23 14AWG wires

Cabinet Size Considerations With the Extended-Depth Housing

When you use an extended-depth housing (1756-TBE), the module depth is increased. Figure 2.16 shows the difference, in terms of depth, between a module using a standard-depth housing and one using an extended-depth housing.

Figure 2.16



IMPORTANT

The depth from front of the module to the back of the chassis is as follows:

- standard-depth housing = 147.91mm (5.823in)
- extended-depth housing = 157.43mm (6.198in)

Installing the Removable Terminal Block

Install the RTB onto the module to connect wiring.

ATTENTION

Shock hazard exists. If the RTB is installed onto the module while the field-side power is applied, the RTB will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

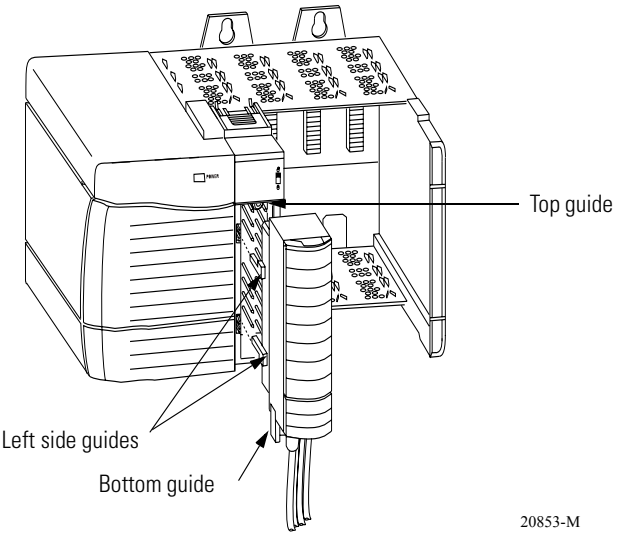
The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature. It is recommended that field-side power be removed before installing the RTB onto the module.

Before installing the RTB, make certain:

- field-side wiring of the RTB has been completed.
- the RTB housing is snapped into place on the RTB.
- the RTB housing door is closed.
- the locking tab at the top of the module is unlocked.

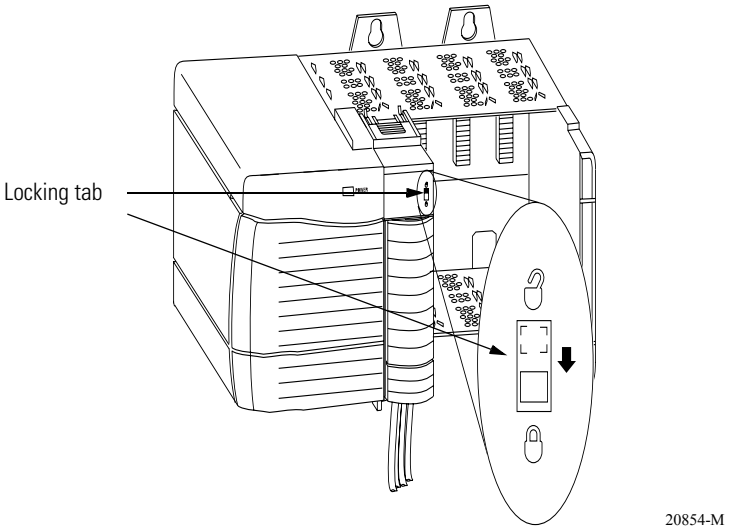
1. Align the top, bottom and left side guides of the RTB with the guides on the module.

Figure 2.17



2. Press quickly and evenly to seat the RTB on the module until the latches snap into place.

Figure 2.18



3. Slide the locking tab down to lock the RTB onto the module.

Removing the Removable Terminal Block

If you need to remove the module from the chassis, you must first remove the RTB from the module.

ATTENTION

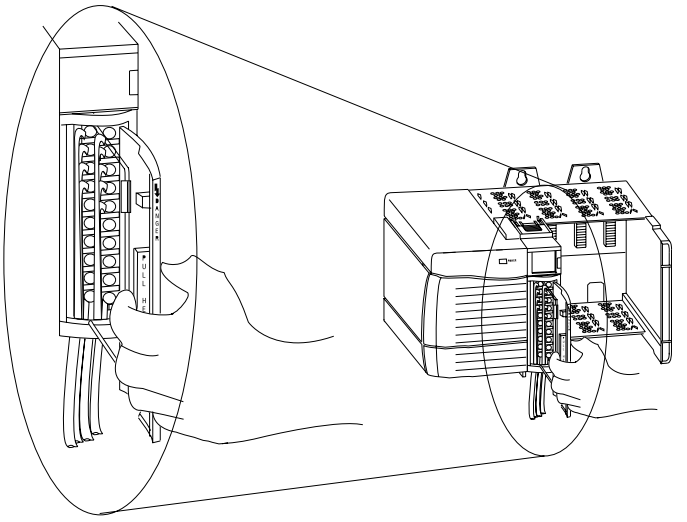
Shock hazard exists. If the RTB is removed from the module while the field-side power is applied, the module will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, **unintended machine motion or loss of process control can occur**. Exercise extreme caution when using this feature. It is recommended that field-side power be removed before removing the module.

1. Unlock the locking tab at the top of the module.
2. Open the RTB door using the bottom tab.
3. Hold the spot marked PULL HERE and pull the RTB off the module.

IMPORTANT Do not wrap your fingers around the entire door. A shock hazard exists.

Figure 2.19



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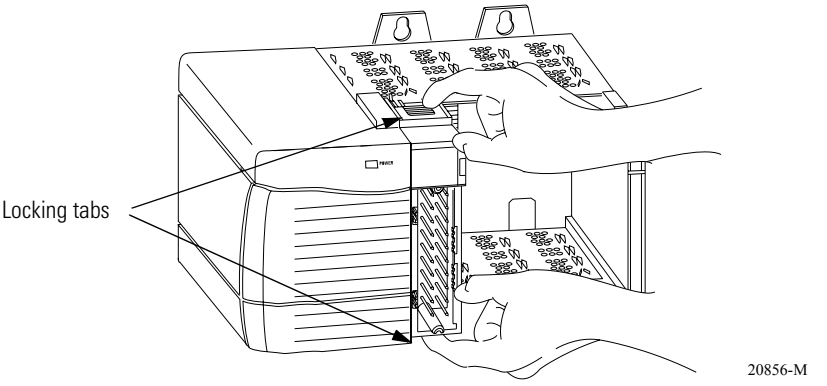
Removing the Module from the Chassis

Follow the steps below to remove the 1756-HYD02 module from the ControlLogix chassis.

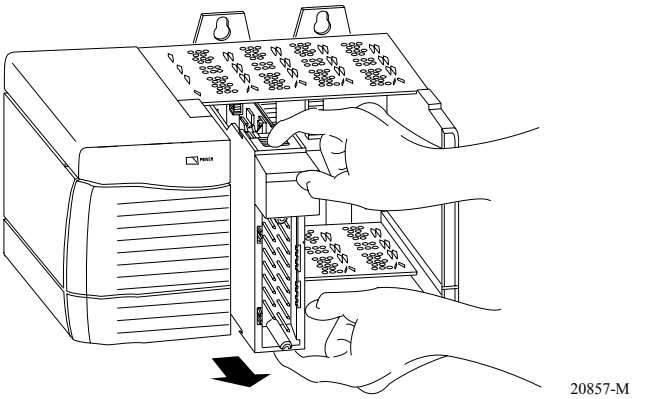
1. Push in the top and bottom locking tabs.

Figure 2.20



2. Pull module out of the chassis.

Figure 2.21



Chapter Summary and What's Next

In this chapter, you read about Installing the 1756-HYD02 Module. Chapter 3 explains Configuring the 1756-HYD02 Module.

Configuring the 1756-HYD02 Module

This chapter describes how to configure a ControlLogix Hydraulic Servo module.

For information about:	See page:
Overview of the Configuration Process	3-2
Creating a New Module	3-3
Configuring General Module Features	3-5
Configuring the Axes Features	3-6
Downloading New Configuration Data	3-7
Editing Configuration	3-8
Reconfiguring Module Parameters in Run Mode	3-9
Reconfiguring Module Parameters in Program Mode	3-9

You must configure your module upon installation. The module does not work until it has been configured.

IMPORTANT The ControlLogix Hydraulic Servo module can only be used in a local chassis.

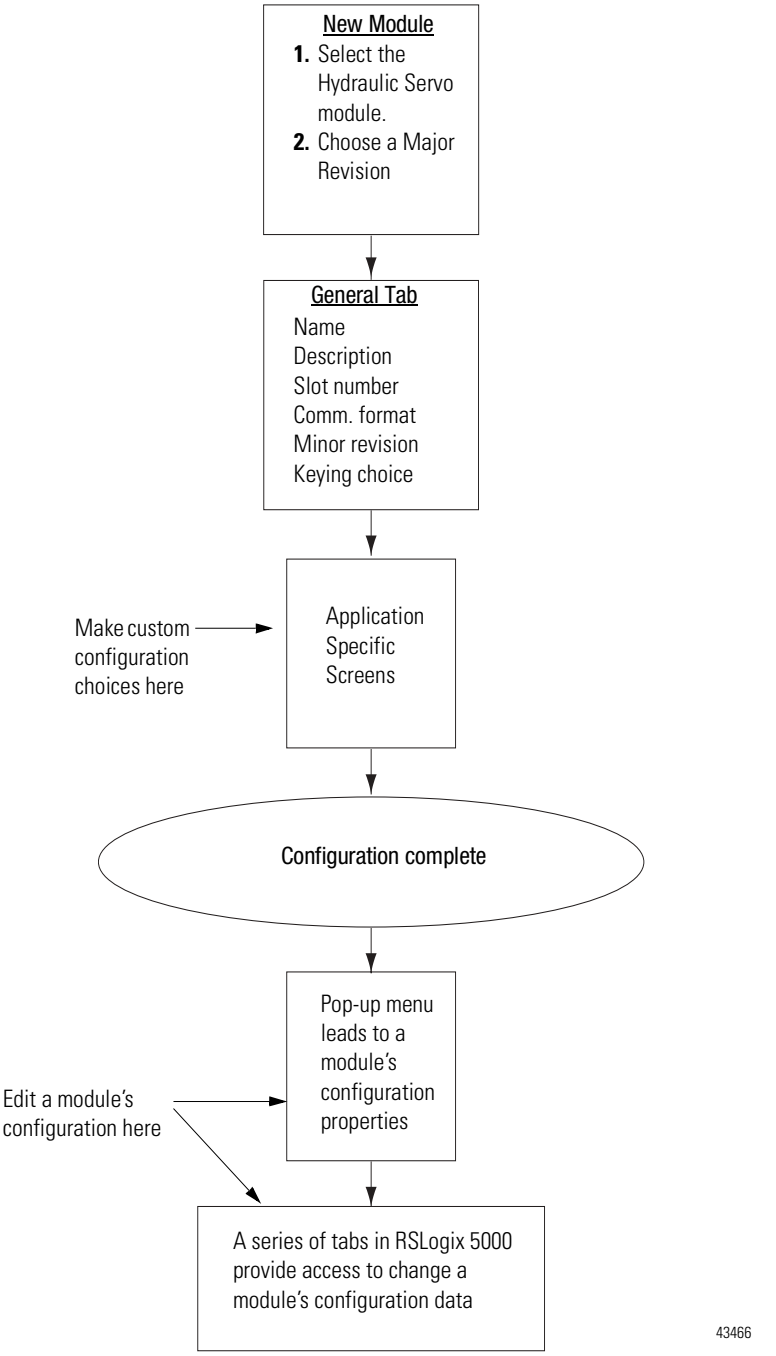
Using RSLogix 5000 Configuration Software

Use RSLogix 5000 software, version 12 or greater, to configure your ControlLogix Hydraulic Servo module.

Overview of the Configuration Process

Figure 3.1 shows an overview of the configuration process.

Figure 3.1



Creating a New Module

After you have started RSLogix 5000 and created a controller, you must create a new module. The wizard allows you to create a new module and configure it.

IMPORTANT You must be offline when you create a new module.

1. If your application is online, go offline.

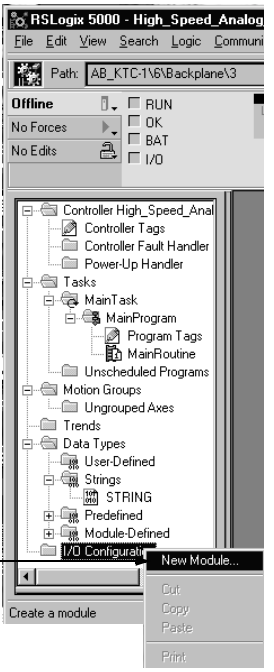
Use this pull-down menu to go offline

2. Access the Select Module Type screen.

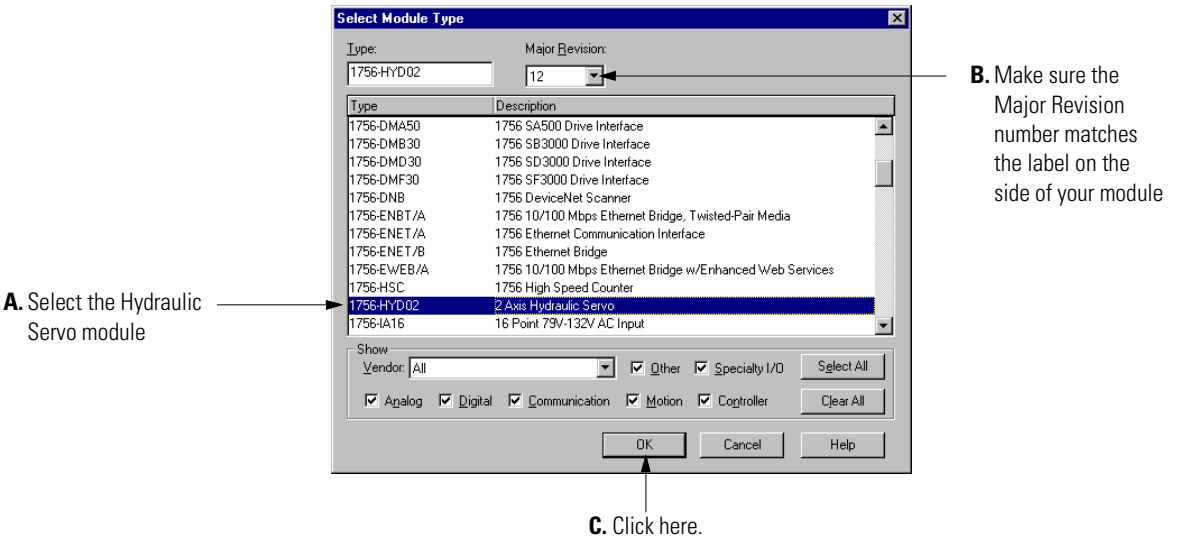
A. Select I/O Configuration.

B. Right-click to see the menu.

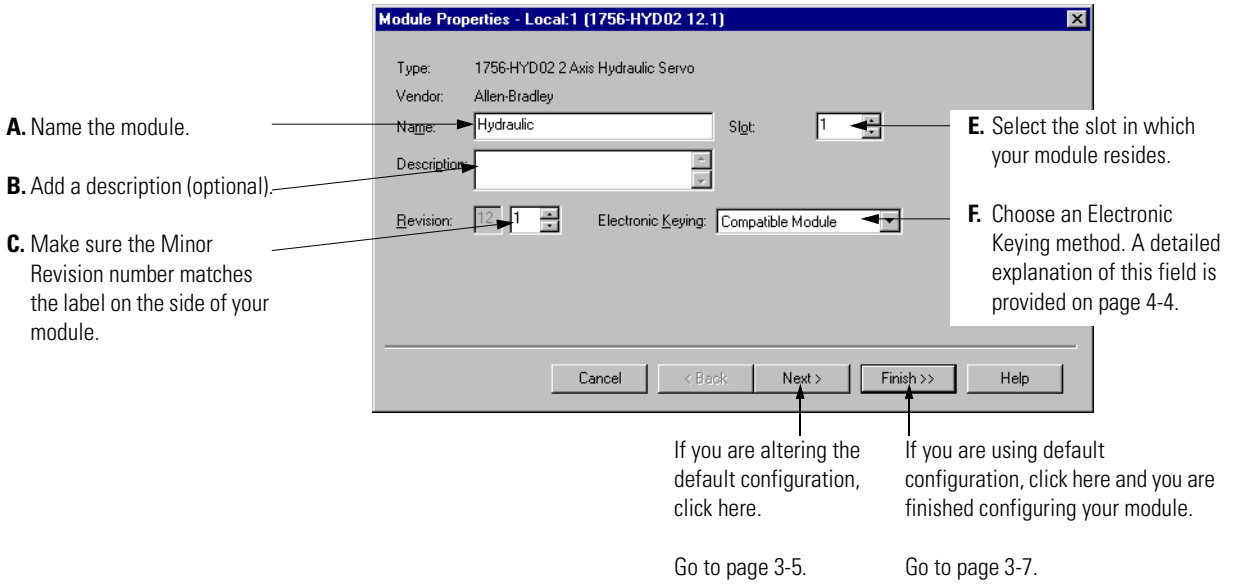
C. Select New Module.



3. Select the module type.

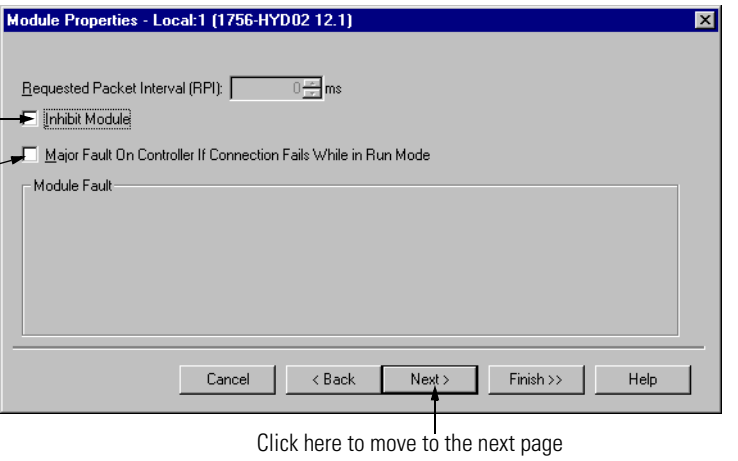


4. Begin configuration on the naming screen.


Module Properties - Local:1 (1756-HYD02 12.1)
Type: 1756-HYD02 2 Axis Hydraulic Servo
Vendor: Allen-Bradley
Name: Hydraulic
Slot: 1
Description:
Revision: 12 1
Electronic Keying: Compatible Module
Cancel
< Back
Next >
Finish >>
Help
A. Name the module.
B. Add a description (optional).
C. Make sure the Minor Revision number matches the label on the side of your module.
E. Select the slot in which your module resides.
F. Choose an Electronic Keying method. A detailed explanation of this field is provided on page 4-4.
If you are altering the default configuration, click here.
Go to page 3-5.
If you are using default configuration, click here and you are finished configuring your module.
Go to page 3-7.

Configuring General Module Features

You see the series of wizard screens after the naming screen. Use these screens to configure general features on the 1756-HYD02 module.

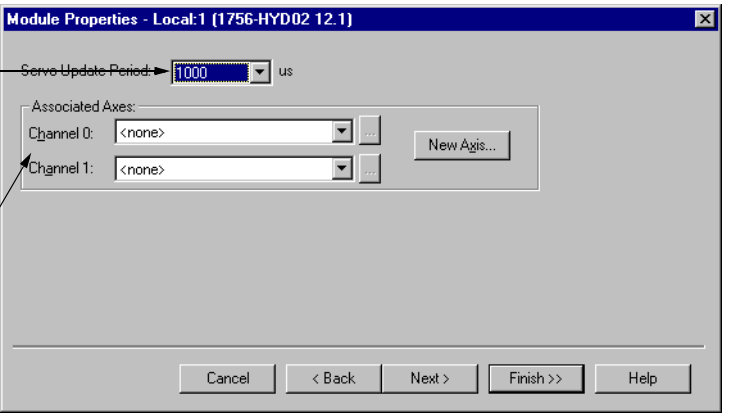


Inhibit the connection to the module

If you want a Major Fault on the Controller to occur if there is connection failure with the I/O module while in Run mode, click here

This Fault box is empty when you are offline. If a fault occurs while the module is online, the type of fault will be displayed here

Click here to move to the next page



Set the Servo Update Period – The correct servo update period is based on the transducer lengths and the number of recirculations on each axis associated with the module. The Feedback tab, described on page 4-12, has a utility that calculates the minimum update period.

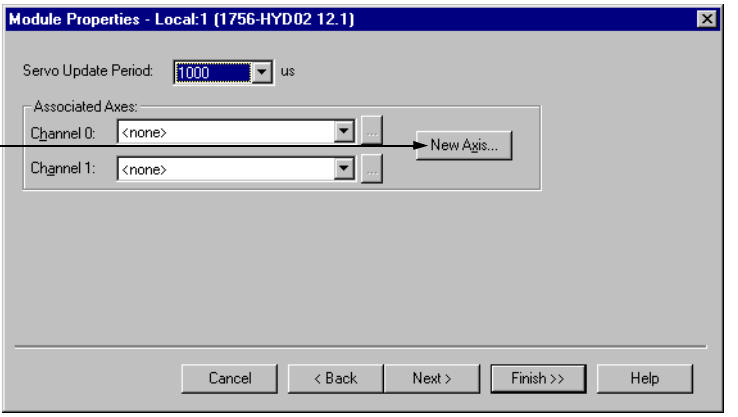
For more information on the Associated Axes, see the Configuring the Axes Features beginning on page 3-6.

Configuring the Axes Features

You must create an axis before you can associate it with a channel on the 1756-HYD02 module.

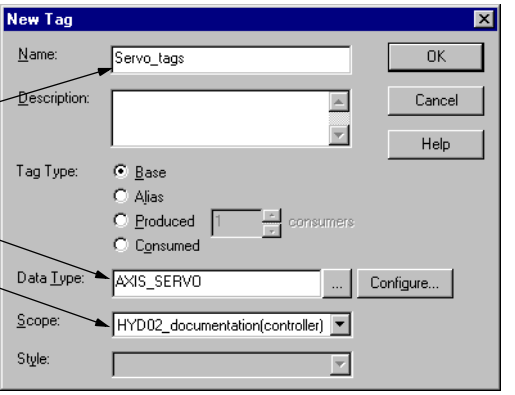
1. Create the new axis tag as shown below.

Click on New Axis to create a new axis tag that will contain the axis data. The New Tag pop-up screen appears, as shown below.



The new axis tag must be:

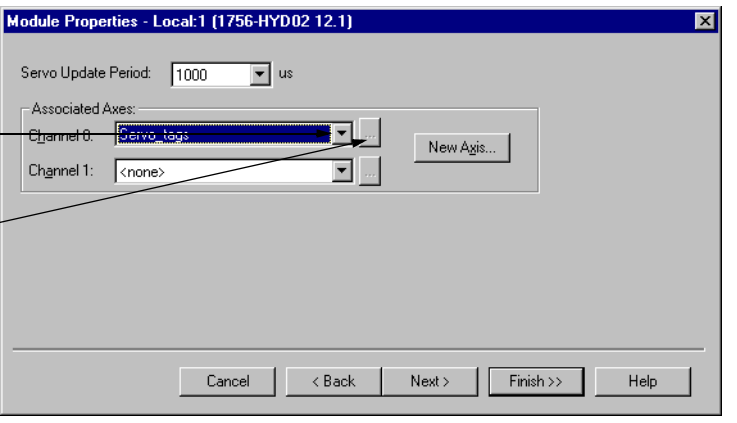
- named
- of the AXIS_SERVO data type
- of the controller scope



2. Access the axis properties as shown below.

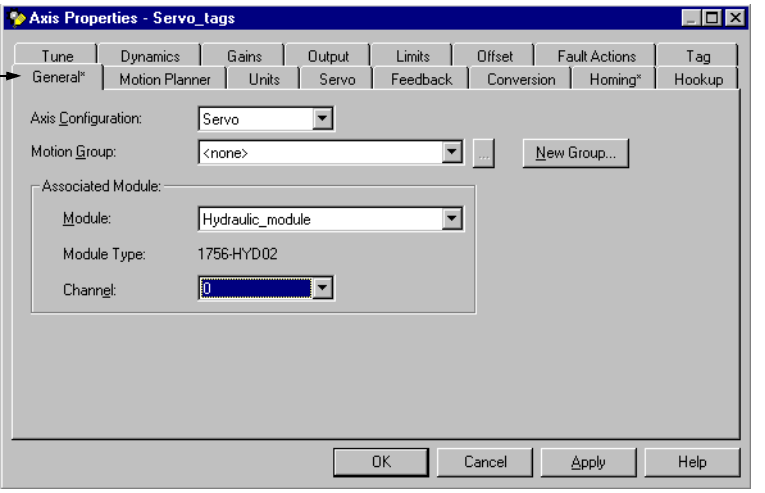
A. Associate the channel(s) with the new axis tag.

B. Click on the ellipsis (. . .) to access the axis properties wizard.



3. Configure the axis properties on the wizard screens that appear. The General screen is shown below.

Click on the necessary tab and make changes to the axis properties.

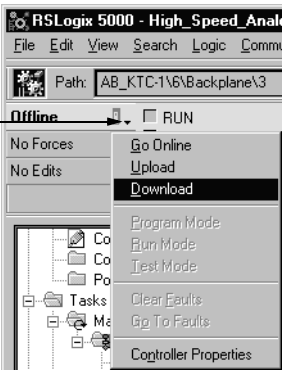


For a full description of all the configurable features available on the Axis properties wizard, see the Using Axes Features section beginning on page 4-6.

Downloading New Configuration Data

After you have changed the configuration data for a module, the change does not actually take effect until you download the new program which contains that information. This downloads the entire program to the controller overwriting any existing programs.

Use this pull-down menu to download the new configuration.



This completes the download process.

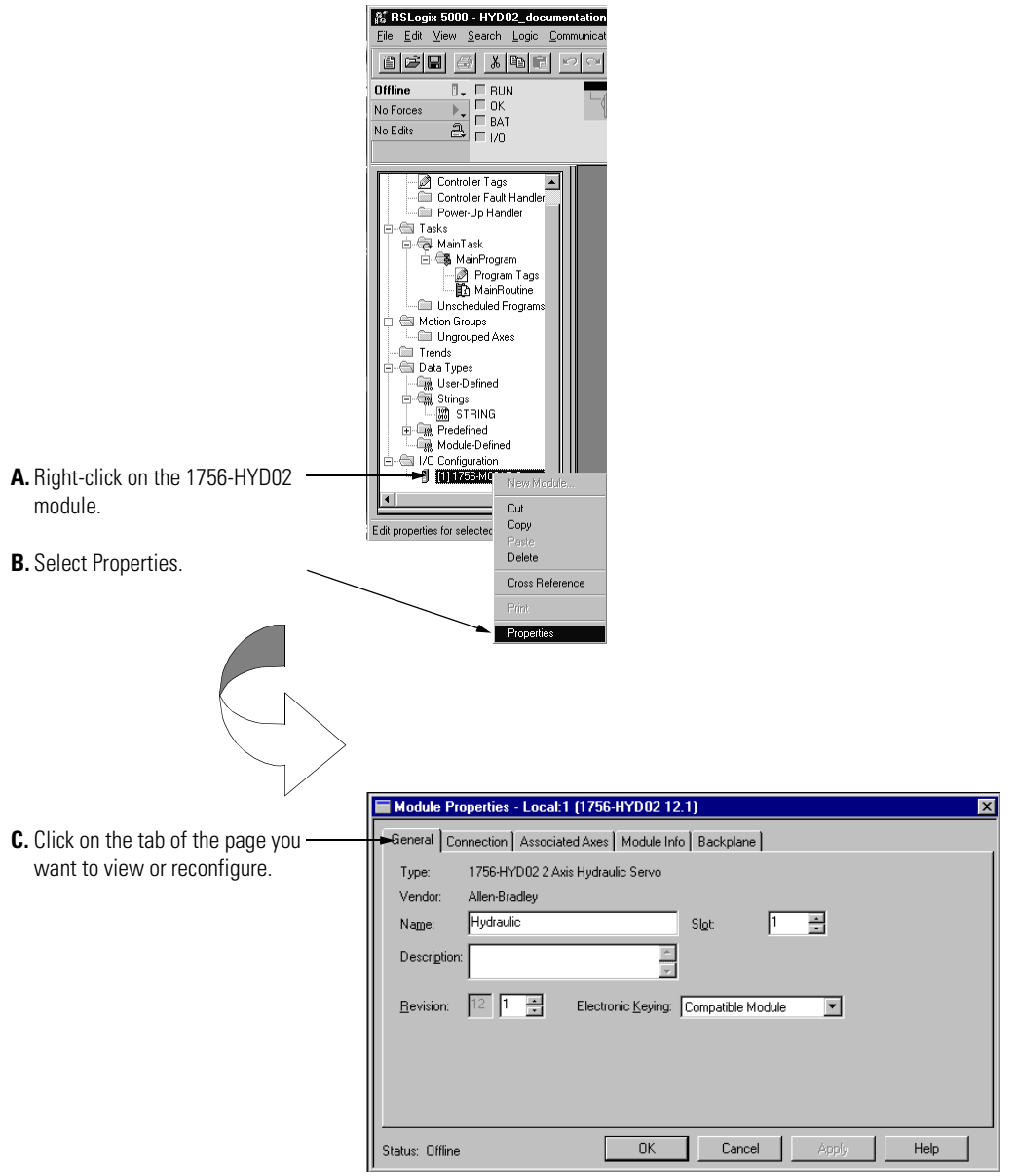
Editing Configuration

After you set configuration for a module, you can review and change it. You can change configuration data and download it to the controller while online. This is called **dynamic reconfiguration**.

Your freedom to change some configurable features, though, depends on whether the controller is in Remote Run mode or Program mode.

IMPORTANT Although you can change configuration while online, you must go offline to add or delete modules from the program.

The editing process begins on the main page of RSLogix 5000.



Reconfiguring Module Parameters in Run Mode

Your module can operate in Remote Run mode or Hard Run mode. You can only change any configurable features that are enabled by RSLogix 5000 in Remote Run mode.

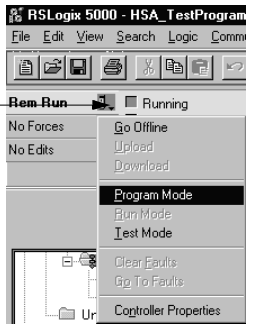
If any feature is disabled in either Run mode, change the controller to Program mode and make the necessary changes.

Reconfiguring Module Parameters in Program Mode

Follow these steps to change configuration in Program mode.

1. Make sure the module is in Program Mode.

Use this pull-down menu to switch to Program mode



2. Make any necessary changes.

3. Download the new configuration.

Use this pull-down menu to download the new configuration.

4. Return to Run Mode, if necessary.

Chapter Summary and What's Next

In this chapter you read about:

- configuring ControlLogix Hydraulic Servo modules
- editing module configuration
- configuration tags

Chapter 4 explains Using the 1756-HYD02 Module Features.

Using the 1756-HYD02 Module Features

This chapter describes the 1756-HYD02 module's configurable features.

For more information about:	See page:
What This Chapter Contains	4-2
Using General Module Features	4-2
Servo Update Period	4-2
Module Fault Reporting	4-3
Fully Software Configurable	4-3
Electronic Keying	4-4
Status Indicator Information	4-5
Using Axes Features	4-6
General Tab	4-6
Motion Planner Tab	4-8
Units Tab	4-10
Servo Tab	4-11
Feedback Tab	4-12
Conversion Tab	4-13
Homing Tab	4-13
Hookup Tab	4-16
Tune Tab	4-17
Dynamics Tab	4-18
Gains Tab	4-19
Output Tab	4-22
Limits Tab	4-24
Offset Tab	4-26
Fault Actions Tab	4-28
Tag Tab	4-30

What This Chapter Contains

This chapter is broken into the two sections.

Table 4.1

Section:	Description:	Begins on page:
Using General Module Features	This section describes features that affect the module in a general sense. For example, the 1756-HYD02 module offers electronic keying options that you can configure to set the degree of protection your application needs against using the wrong 1756-HYD02 module.	4-2
Using Axes Features	This section describes features that are specific to the axes connected to channels 0 and 1 on the 1756-HYD02 module.	4-6

Using General Module Features

The general module features include:

- Servo Update Period
- Module Fault Reporting
- Fully Software Configurable
- Electronic Keying
- Status Indicator Information

Servo Update Period

Servo update period is the period at which the position feedback is sampled and the loop is closed to generate a new output value. The time of this period is a user-defined setting. You can choose from one of the following settings:

- 250µs
- 500µs
- 1000µs
- 1500µs
- 2000µs

With LDTs, the minimum Servo Update Period is dependent on the length of the transducer. Use the Calculated Values tool on the Feedback tab of the Axis properties dialog in RSLogix 5000, in conjunction with the response of your hydraulic application, to calculate suggested minimum update periods. The coarse update period of the associated motion group must be at least 3x the maximum configured 1756-HYD02 module servo update period or RSLogix 5000 will generate an error.

Module Fault Reporting

The 1756-HYD02 module provides hardware and software indication when a module fault has occurred. The module's LED fault indicator and the RSLogix 5000 programming software graphically display faults; the software also offers a message describing the nature of the fault. This feature allows you to determine how your module has been affected and what action should be taken to resume normal operation.

For more information on using RSLogix 5000 to troubleshoot your module, see Chapter 5, Troubleshooting the 1756-HYD02 Module.

Fully Software Configurable

The RSLogix 5000 software offers a custom, easily understood interface for users to write configuration. All module features are enabled or disabled through the configuration portion of the software.

You can also use the software to interrogate any module in the system to retrieve

- serial number
- revision information
- catalog number
- vendor identification
- error/fault information
- diagnostic counters.

By eliminating such tasks as setting hardware switches and jumpers, the software makes module configuration easier and more reliable.

Electronic Keying

Instead of plastic mechanical backplane keys, electronic keying allows the ControlLogix system to control what modules belong in the various slots of a configured system.

During module configuration, you must choose one of the following keying options for your I/O module:

- Exact Match
- Compatible Match
- Disable Keying

When the controller attempts to connect to and configure a Hydraulic Servo module (e.g. after program download), the module compares the following parameters (assuming keying is not disabled) before allowing the connection and configuration to be accepted:

- Vendor
- Product Type
- Catalog Number
- Major Revision - Change that affects the module's function or RSLogix 5000 interface
- Minor Revision - Change that does not affect the module's function or RSLogix 5000 interface

The comparison is made between the keying information present in the module and the keying information in the controller's program. This feature can prevent the inadvertent operation of a control system with the wrong module in the wrong slot.

Exact Match

All of the parameters listed above must match or the controller rejects a connection to the inserted module.

Compatible Match

The Compatible Match mode allows a Hydraulic Servo module to determine whether it can emulate the module defined in the configuration sent from the controller.

With the ControlLogix Hydraulic Servo module, the module can emulate older revisions. The module accepts the configuration if the configuration's major.minor revision is less than or equal to the physical module's revision.

For example, if the configuration contains a major.minor revision of 2.7, the module inserted into the slot must have a firmware revision of 2.7 or higher to make a connection.

Disable Keying

The inserted module attempts to accept a connection to the controller regardless of its type.

ATTENTION

Be extremely cautious when using the disable keying option; if used incorrectly, this option can lead to personal injury or death, property damage or economic loss.

A controller does not establish a connection if any of the following conditions exist, even if keying is disabled:

- The slot is configured for one module type (e.g. 1756-MO2AE module) and a module of another type (e.g. 1756-HYD02 module) is inserted in the slot.
- The module inserted into the slot cannot accept some portion of the configuration.

Status Indicator Information

The 1756-HYD02 module uses a single bi-colored LED to indicate module OK status and bi-colored LED indicators to show individual feedback (FDBK) and drive (DRIVE) status for both axes.

For more information on using the status indicators, see Chapter 5, Troubleshooting the 1756-HYD02 Module.

Using Axes Features

Associated axes can be connected to channels 0 and 1 on the 1756-HYD02 module during initial configuration or on the Associated Axes tab of the module's properties in RSLogix 5000.

IMPORTANT When configuring Servo Axes features, remember the following:

- The 1756-HYD02 module only works with AXIS_SERVO data type tags.
- When a parameter transitions to a read-only state, any pending changes to parameter values are lost, and the parameter reverts to the most recently saved parameter value.
- When multiple workstations connect to the same controller using RSLogix 5000 and invoke the Axis Wizard or Axis Properties dialog, the firmware allows only the first workstation to make any changes to axis attributes. The second workstation switches to a Read Only mode, indicated in the title bar, so that you may view the changes from that workstation, but not edit them.

After you have created an AXIS_SERVO tag, you must configure the axis connected to that tag. You configure the axis properties on a series of tabs in RSLogix 5000. The tabs that are available in the axis properties portion of RSLogix 5000 are described in the rest of this section.

For more information on how to configure the Axes Servo features, or anything else on the 1756-HYD02 module, see Chapter 3, Configuring the 1756-HYD02 Module or the RSLogix 5000 online help.

General Tab

Table 4.2 lists the configurable features available on the General tab.

Table 4.2

Feature:	Definition:
Axis Configuration	Selects and displays the intended use of the axis. • **Feedback Only** - If the axis is to be used only to display position information from the feedback interface. This selection minimizes the display of axis properties tabs and parameters. • **Servo** - If the axis is to be used for full closed loop operation. This selection maximizes the display of axis properties tabs and parameters.
Motion Group	Selects and displays the Motion Group to which the axis is associated. An axis assigned to a Motion Group appears in the Motion Groups branch of the Controller Organizer, under the selected Motion Group sub-branch. Selecting <none> terminates the Motion Group association, and moves the axis to the Ungrouped Axes sub-branch of the Motions Groups branch.
Ellipsis button (. . .)	Opens the Motion Group Properties dialog box for the Assigned Motion Group, where you can edit the properties of the Assigned Motion Group. If no Motion Group is assigned to this axis, this button is disabled.
New Group	Opens the New Tag dialog box, where you can create a new Motion Group tag. This button is enabled only if you have not created a Motion Group tag.
Module	Selects and displays the name of the motion module to which the axis is associated. Displays <none> if the axis is not associated with any motion module.
Module Type	This read-only field displays the type of motion module, if any, associated with the axis. Displays <none> if the axis is not associated with any motion module.
Channel	Selects and displays the channel–either 0 or 1–to which the axis is assigned. Disabled when the axis is not associated with any motion module.

Motion Planner Tab

Table 4.3 lists the configurable features available on the Motion Planner tab.

Table 4.3

Feature:	Definition:
Output Cam Execution Targets	Use this field to set the maximum number of output cams that will be used on the axis. This value allocates controller memory to allow the motion planner to build CAM association tables.
Program Stop Action	Select how a specific axis stops when the controller undergoes a mode change, or when a Motion Group Stop (MGS) instruction is executed: • **Fast Disable**: The axis is decelerated to a stop using the current configured value for maximum deceleration. Loop closure is maintained until the axis motion has stopped; at that time, the axis is disabled (i.e., Drive Enable is disabled, and the axis loop is disabled). • **Fast Shutdown**: The axis is decelerated to a stop using the current configured value for maximum deceleration. Once the axis motion is stopped, the axis is placed in the shutdown state (i.e., Drive Enable is disabled, the loop is disabled, and the OK contact is opened). To recover from this state, a reset instruction must be executed. • **Fast Stop**: The axis is decelerated to a stop using the current configured value for maximum deceleration. Loop closure is maintained after the axis motion has stopped. This mode is useful for gravity or loaded systems, where closed loop control is needed at all times. • **Hard Disable**: The axis is immediately disabled (i.e. Drive Enable is disabled, the axis loop is disabled, but the OK contact is left closed). Unless the drive is configured to provide some form of dynamic breaking, this selection results in the axis coasting to a stop. • **Hard Shutdown**: The axis is immediately placed in the shutdown state (i.e. Drive Enable is disabled, the axis loop is disabled, but the OK contact is left open). Unless the drive is configured to provide some form of dynamic breaking, this selection results in the axis coasting to a stop. To recover from this state, a reset instruction must be executed.

Table 4.3

Feature:	Definition:
Master Delay Compensation	Master Delay Compensation helps a slave approach zero tracking error when gearing or camming to the actual position of a master axis. When camming or gearing off of actual feedback, some delay exists between when the master position data is generated and when the controller acts on that data for a slave. This delay causes a slave response to lag behind a master. You can compensate for this delay with the Master Delay Compensation. The Position Camming and Gearing functions, when applied to a slave axis, perform Master Delay Compensation to compensate for the delay time between reading the master axis command position and applying the associated slave command position to the output of the slave's axis loop. When the master axis is running at a fixed speed, this compensation makes sure that the slave axis command position accurately tracks the actual position of the master axis. The Master Delay Compensation algorithm extrapolates the position of the master axis at the predicted time when the command position will be applied to the slave's axis loop. The total position update delay created by the Coarse Update Period of the motion group, and, if the master or the slave involves an AXIS_SERVO_DRIVE data type, it also includes the delay term that is proportional to the SERCOS Update Period. The motion planner implements a 1st order extrapolation algorithm that results in zero tracking error while the master axis is moving at constant velocity. If the master axis accelerates or decelerates the tracking error is non-zero and proportional to the acceleration or deceleration rate and also proportional to the square of the total position update delay time. If your application does not require zero tracking error between the master and the slave axis, disable the Master Delay Compensation feature to eliminate the disturbances the extrapolation algorithm introduces to the slave axis. When the Master Delay Compensation feature is disabled (bit cleared), the slave axis appears to be more responsive to the master's movements, and runs generally smoother than when Master Delay Compensation feature is enabled (bit set). However, when the master axis is running at a constant velocity, the slave lags the master by a tracking error that is proportional to the speed of the master. Since the master axis position is measured in discrete feedback counts and is inherently noisy, the extrapolation process amplifies that noise according to the total position update delay. The greater the delay, the greater the noise introduced by the extrapolator. This feature also includes an extrapolation filter to filter the noise introduced by the extrapolation process. The time constant of the filter is fixed at 4x the total position update delay (independent of the Master Position Filter Bandwidth), which again is a function of the Coarse Update Period and the SERCOS Update Period, if a AXIS_SERVO_DRIVE data type. Note that Master Delay Compensation, even if explicitly enabled, is not applied in cases where a slave axis is gearing or camming to the master axis' command position. Since the ControlLogix controller generates the command position directly, there is no intrinsic master position delay to compensate for.
Enable Master Position Filter	When checked, this field enables the Master Position filter to eliminate high frequency oscillations or spikes from the master position signal being sent to the 1756-HYD02 module. High speed axis oscillation typically causes the oscillations and spikes in the signal. By removing the high frequency noise, the application may be able to accurately operate on true variation of the master position signal. Caution should be used when applying filtering since, by definition, it makes the system less responsive.
Master Position Filter Bandwidth	Bandwidth used on the Master Position filter. The servo position loop is also a filter. To be effective, the master position filter bandwidth should be less than or equal to position loop bandwidth. However, remember that this filter adds propagation delay.

Units Tab

Use the Units tab to determine the programming and configuration units used to define your motion axis. When RSLogix 5000 software is online and the controller transitions to hard run, or the axis loop is on (i.e., active), then all the attributes on this tab transition to a read only state. When any attribute transitions to a read only state, then any pending attribute changes are reverted.

Table 4.4 lists the configurable features available on the Units tab.

Table 4.4

Feature:	Definition:
Position Units	User-defined engineering units (rather than feedback counts) used to label all motion-related values (e.g., position or velocity) These position units can be different for each axis. Position Units should be chosen for maximum ease of use in your application. For example, linear axes might use position units of inches or meters whereas rotary axes might use units of revolutions or degrees.
Average Velocity Timebase	Specifies the time (in seconds) to be used to calculate the average velocity of the axis. This value is computed by taking the total distance the axis travels in the amount of time specified, and dividing this value by the timebase. The average velocity timebase value should be large enough to filter out the small changes in velocity that would result in a "noisy" velocity value, but small enough to track significant changes in axis velocity. A value of 0.25 to 0.50 seconds should work well for most applications.

Servo Tab

For an axis of the data type AXIS_SERVO, configured for Servo operation (i.e. closed loop operation) in the General tab of this dialog box, use the SERVO tab to:

- configure an external drive.
- configure the drive fault input.
- select up to two axis attributes whose status can be monitored.

Table 4.5 lists the configurable features available on the Servo tab.

Table 4.5

Feature:	Definition:
External Drive Configuration	Select the Hydraulic drive type. This drive type selection enables proportional, integral and differential (PID) position loop gains with Feed-Forwards and Directional scaling for the axis loop. The Torque and Velocity options are not valid on the 1756-HYD02 module.
Loop Configuration	Currently, only Position Servo is available.
Enable Drive Fault Input	When selected, this feature enables the drive fault input. When the drive fault is detected, appropriate action is taken based on the Drive Fault Action specified in the Fault Actions tab of this dialog box. On hydraulic systems, you can use this input if the valve or hydraulic power unit has an output indicating a fault condition.
Drive Fault Input - Normally Open or Closed	Specifies the usual state of the drive fault output: • Normally Open - sources current when a fault is present • Normally Closed - sources current when a fault is not present
Enable Direct Drive Ramp Control	Check this box to enable direct drive ramp rate control.
Direct Drive Ramp Rate	This attribute specifies the rate at which the analog output changes from the current value to the requested value when a Motion Direct Drive On (MDO) command is given. The ramp rate is specified in V/s. The value should be selected to allow the axis to change speed rapidly without causing excessive shock.
Real Time Axis Information - Attribute 1	The first axis attributes whose status is transmitted – along with the actual position data – to the Logix processor. Once the attribute is selected, the real time axis information is automatically updated in the axis tag structure, as long as Auto Tag Update is enabled. If a GSV is done to one of these loop status attributes without having selected this attribute via the Real Time Axis Information attribute, the attribute value will be static and will not reflect the true value in the hydraulic module.
Real Time Axis Information - Attribute 2	The second axis attributes whose status is transmitted – along with the actual position data – to the Logix processor. Once the attribute is selected, the real time axis information is automatically updated in the axis tag structure, as long as Auto Tag Update is enabled. If a GSV is done to one of these loop status attributes without having selected this attribute via the Real Time Axis Information attribute, the attribute value will be static and will not reflect the true value in the hydraulic module.

Feedback Tab

Use the Feedback tab to select a feedback type. RSLogix 5000 displays multiple feedback types for the 1756-HYD02 module. At this release of the 1756-HYD02 module, only the LDT type is available. Table 4.6 lists the configurable features available on the LDT feedback option.

Table 4.6

Feature:	Definition:
LDT Type	Selection determines what type of LDT provides feedback to the 1756-HYD02 module. • PWM - also called Gated or DPM • Start/Stop Rising Edge • Start/Stop Falling Edge
Recirculations	Recirculations is the process of acquiring a measurement from an LDT. You can repeat the measurement process several times for each interrogation. The repetition of the measurement process is done automatically inside LDTs with PWM type output. When configuring the LDT, you can select the number of times the process is repeated; that number is used in this field. Note that this field is enabled only if you have chosen PWM for LDT Type.
Calibration Constant	The calibration constant (also called Gradient on some LDTs) is a number that is engraved on each LDT by the manufacturer. It specifies the characteristics of that individual transducer. Because each transducer has its own calibration constant, this number is used to calculate the conversion constant for the axis; the conversion constant changes when an LDT is changed on an axis. To calculate the **Minimum Servo Update Period**, use one of the following formulas: For μs/in: Minimum Servo Update Period = [Length (in) X Calibration Constant (μs/in) + Recirculation delay (approx. 25μs)] X Recirculations For m/s: Minimum Servo Update Period = [Length (m) X Calibration Constant (m/s) + Recirculation delay (approx. 0.000025s)] X Recirculations These formulas do not assume a pre-existing calibration constant or conversion constant. Also, for an LDT with SSI interface the formulas above apply. However, the specifications for LDTs with SSI interface vary in nature; we recommend that you apply the manufacturers update period recommendations rather than have RSLogix 5000 compute a minimum servo update period. If it is a rotary (non-LDT) transducer with SSI interface then the Servo Update Period can be simply defaulted to 250 μs. Since both axes of the module must be updated at the module's configured servo update rate, make sure the selected Servo Update Period on the Associated Axes tab is greater than the largest computed limit value above for the two axes associated with the module. To calculate the **new conversion constant when an LDT is changed**, use one of the following formulas: If the calibration constant is in μs/in: $\text{New conversion constant} = \frac{\text{Old conversion constant X New calibration constant}}{\text{Old calibration constant}}$ If the calibration constant is in m/s: $\text{New conversion constant} = \frac{\text{Old conversion constant X Old calibration constant}}{\text{New calibration constant}}$ You must type the new conversion constant in the Conversion Constant field on the Conversion tab. RSLogix 5000 does not automatically update the field after you use the Calculate button on this tab.
Length	LDT length defines the stroke of travel of the hydraulic cylinder. LDT length is used with the number of recirculations to calculate the minimum servo update period.
Scaling	Scaling defines the relationship between the transducer unit of measure, as defined in the transducer length field, and the user's unit of measure (e.g. 39.37 inches/meter) defined on the Units tab.
Enable Absolute Feedback	Absolute Feedback is always enabled for LDT.

Table 4.6

Feature:	Definition:
Absolute Feedback Offset	The absolute offset is used to place the machine zero point at the desired location relative to the zero point of the LDT. The LDT zero point is inside the transducer head and physically unattainable.
Calculated Values:Conversion Constant	Calculation derived from values based on the configuration values entered for the LDT. The calculated conversion "K" constant is derived based on the LDT configuration values entered on the Feedback tab. After proper LDT values are entered and the Calculate button is selected, the resultant "K" value is calculated. This "K" value must be taken from this tab and entered in as the Conversion constant on the Conversion tab. You must type the new conversion constant in the Conversion Constant field on the Conversion tab. RSLogix 5000 does not automatically update the field after you use the Calculate button on this tab.
Calculated Values:Minimum Servo Update Period	Calculation derived from values based on the configuration values entered for the LDT. You can use the calculate button located on the Feedback tab to calculate the appropriate K constant value. The calculated K constant is derived based on the LDT configuration values entered on the Feedback tab, and must be taken from that tab and used here.

Conversion Tab

Use this tab to view the Positioning Mode and configure the Feedback Resolution for an axis. Table 4.7 lists the configurable features available on the Conversion tab.

Table 4.7

Feature:	Definition:
Positioning Mode	The Linear positioning mode is the only positioning mode available on the 1756-HYD02 module. This mode provides a maximum total linear travel of 230,000 feedback counts. With this mode, the unwind feature is disabled and you can specify the positive and negative travel limits for the axis to limit the linear travel distance traveled by the axis.
Conversion Constant	Type the number of feedback counts per position unit. This conversion – or "K" – constant allows axis position to be displayed, and motion to be programmed, in the position units set in the Units tab. The conversion constant is used to convert axis position units into feedback counts and vice versa. You can calculate this value on the Feedback tab.

Homing Tab

Table 4.8 lists the configurable features available on the Homing tab.

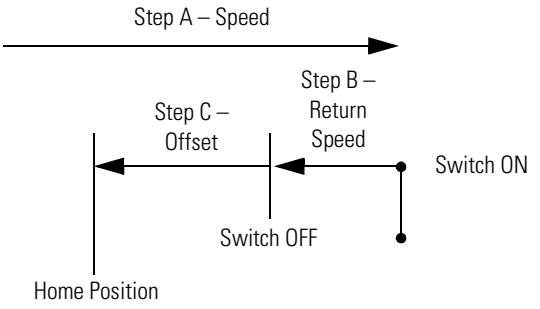
Table 4.8

Feature:	Definition:

Mode	Select one of the following homing modes:
	• **Active**: The homing sequence automatically moves the axis to find the home switch. Active homing sequences use the trapezoidal velocity profile.
	• **Passive**: Homing redefines the absolute position of the axis on the occurrence of a home switch. Passive homing is most commonly used to calibrate uncontrolled axes, although it can also be used with controlled axes to create a custom homing sequence. Passive homing, for a given home sequence, works similar to the corresponding active homing sequence, except that no motion is commanded; the controller just waits for the switch events to occur.
	• **Absolute**: The absolute homing process applies the configured Home Position to the reported position of the absolute feedback device to establish the true absolute position of the axis. The only valid Home Sequence for an absolute Homing Mode is immediate.
	The following examples assume that an initial motion is in a positive axial direction.
	• Active Homing Configurations
	  • Active Immediate Home
	  • Active Bi-directional Home with Switch
	  • Active Uni-directional Home with Switch
	• Passive Homing Configurations
	  • Passive Immediate Home
	  • Passive Home with Switch

Position	This value, listed in position units, specifies the axis' absolute position after the specified homing sequence has been completed. In most cases, this position will be set to zero, although any value within the software travel limits can be used. After the homing sequence is complete, the axis is left in this position.
Offset	Type the desired offset (if any) in position units the axis is to move, upon completion of the homing sequence, to reach the home position. In most cases, this value will be zero.
Sequence	Select which event sets the Home Position: • **Immediate**: Sets the Home Position to the present actual position, without motion. • **Switch**: Sets the Home Position when axis motion encounters a home limit switch.
Limit Switch	Specifies the usual state of the home limit switch: • Normally Open • Normally Closed

Table 4.8

Feature:	Definition:
Active Home Sequence Group: Direction	For active homing sequences, except for the Immediate Sequence type, select the desired homing direction: • **Forward Bi-directional** - The following events occur: a. The axis moves forward at the rate specified in the Speed field until a homing event occurs (i.e. a switch turns ON). b. When the switch turns ON, the axis reverses its direction at the rate specified in the Return Speed field until the switch turns OFF. c. If an Offset value is specified, the axis continues in reverse for the corresponding distance. When the axis stops moving, it is in the Home Position. The graphic below shows this sequence.  • **Forward Uni-directional** – The following events occur: a. The axis moves forward at the rate specified in the Speed field until a homing event occurs (i.e. a switch turns ON). b. When the switch turns ON, the axis continues forward at the rate specified in the Return Speed field until the switch turns OFF. c. If an Offset value is specified, the axis continues forward the corresponding distance. When the axis stops moving, it is in the Home Position. • **Reverse Bi-directional** – The following events occur: a. The axis moves in reverse at the rate specified in the Speed field until a homing event occurs (i.e. a switch turns ON). b. When the switch turns ON, the axis moves forward at the rate specified in the Return Speed field until the switch turns OFF. c. If an Offset value is specified, the axis continues moving forward the corresponding distance. When the axis stops moving, it is in the Home Position. • **Reverse Uni-directional** – The following events occur: a. The axis moves in reverse at the rate specified in the Speed field until a homing event occurs (i.e. a switch turns ON). b. When the switch turns ON, the axis continues in reverse at the rate specified in the Return Speed field until the switch turns OFF. c. If an Offset value is specified, the axis continues in reverse the corresponding distance. When the axis stops moving, it is in the Home Position.
Speed	The moving axis' speed used in the first leg of an active homing sequence. The homing speed specified should be less than the maximum speed and greater than zero.
Return Speed	The moving axis' speed in the return leg(s) of an active homing sequence. The home return speed specified should be less than the maximum speed and greater than zero.

Hookup Tab

Use this tab to configure and initiate axis hookup test sequences for the axis. Table 4.9 lists the configurable features available on the Hookup tab.

Table 4.9

Feature:	Definition:
Test Increment	Specifies the distance the axis travels when executing the Output & Feedback test.
Feedback Polarity	Polarity of the LDT feedback. • Positive • Negative When you execute either the Feedback Test or the Output & Feedback Test, this field is automatically set: When properly configured, this setting makes sure that axis Actual Position value increases when the axis is moved in the user defined positive direction. This feature makes sure that programmatic requests to move in a positive direction result in positive motion on the axis.
Output Polarity	Polarity of the analog output to the drive. • Positive • Negative When you execute the Output & Feedback Test, this field is automatically set: When properly configured, this setting and the Feedback Polarity setting ensure that, when the axis loop is closed, it is closed as a negative feedback system and not an unstable positive feedback system. This feature makes sure that programmatic requests to move in a positive direction result in positive motion on the axis.
Test Feedback	Runs the Feedback Test, which checks and, if necessary, reconfigures the Feedback Polarity setting. When the test is initiated, you must manually move the axis. If physically moving the axis is too difficult, we recommend that you combine Test Feedback and Test Output & Feedback features to cause the movement.
Test Output & Feedback	Runs the Output & Feedback Test, which checks and, if necessary, reconfigures both the polarity of feedback (the Feedback Polarity setting) and the polarity of the output to the valve (the Output Polarity setting), for an axis configured for Servo operation in the General tab of this dialog box. Executing any test operation automatically saves all changes to axis properties.

Tune Tab

Table 4.10 lists the configurable features available on the Tune tab.

Table 4.10

Feature:	Definition:
Travel Limit	Sets the axis' travel limit during the tune test. If the hydraulic module determines that the axis will not be able to complete the tuning process before exceeding the tuning travel limit, it will terminate the tuning profile and report that this limit was exceeded.
Speed	Sets the maximum speed for the tune process. This value should be set to the desired maximum operating speed of the axis (in engineering units) prior to running the tune test.
Direction	Sets the direction of the tuning motion profile. Negative indicates reverse direction; positive indicates forward direction.
Tune	Selects the gains to be determined by the tuning test: • Position Error Integrator • Velocity Feedforward • Output Filter • Velocity Error Integrator

Start Tuning	Begins the tuning test. If the tuning process completes successfully, the following attributes are set:
	• **Gains tab** - Set the following attributes here:
	  • Velocity Feedforward Gain (if checked under Tune, above)
	  • Position Proportional Gain and Position Integral Gain (if checked under Tune, above)
	• **Dynamics tab** - Set the following attributes here:
	  • Maximum Velocity
	  • Maximum Acceleration
	  • Maximum Deceleration
	• **Output tab** - Set the following attributes here:
	  • Velocity Scaling
	  • Low Pass Output Filter (see Note, below)
	• **Limits** - The Position Error Tolerance attribute is set on this tab.
	You can use this selection to adjust bandwidth values as needed. During tuning, if the controller detects a high degree of tuning inertia, it enables the Low Pass Output Filter and calculates and sets a value for Low Pass Output Filter Bandwidth. Executing a Tune operation automatically saves all changes to axis properties.
	ATTENTION: This tuning procedure may cause axis motion with the controller in program mode.

Dynamics Tab

The parameters on this tab can be edited in two ways:

- Type parameter changes in the fields available on this tab and use the OK or Apply buttons to save your edits.
- Edit in the Manual Adjust dialog. To do so:
  a. Click on the Manual Tune button.
  b. Use the spin controls to edit parameter settings.

  Your changes are saved the moment a spin control changes any parameter value.

The parameters on this tab become read-only when the controller is online if the controller is set to Hard Run mode, or if a Feedback On condition exists.

When RSLogix 5000 is offline, the parameters described in Table 4.11 can be edited and the program saved to disk using either the Save command or by clicking on the Apply button. You must re-download the edited program to the controller before it can be run.

Table 4.11 lists the configurable features on the Dynamics tab.

Table 4.11

Feature:	Definition:
Maximum Velocity	The steady-state speed of the axis, it is initially set to Tuning Speed by the tuning process. This value is typically set to about 90% of the maximum speed rating of the motor. We recommend this value be set to 70% of the maximum speed where the maximum pressure is twice the valve-rated pressure and 57% of the maximum speed where the maximum pressure is three times the valve-rated pressure. This provides sufficient "head-room" for the axis to operate at all times within the speed limitations of the motor. Any change in value, caused by manually changing the spin control, is instantly sent to the controller.
Maximum Acceleration	The maximum acceleration rate of the axis, in Position Units/second, it is initially set to approximately 85% of the measured tuning acceleration rate by the tuning process. This provides sufficient "head-room" for the axis to operate at all times within the acceleration limits of the cylinder (or axis). Any change in value, caused by manually changing the spin control, is instantly sent to the controller.
Maximum Deceleration	The maximum deceleration rate of the axis, in Position Units/second, it is initially set to approximately 85% of the measured tuning deceleration rate by the tuning process. This provides sufficient "head-room" for the axis to operate at all times within the deceleration limits of the cylinder (or axis). Any change in value, caused by manually changing the spin control, is instantly sent to the controller.

Gains Tab

Use this tab to perform the following offline functions:

- Adjust gain values that have been automatically set by the tuning process (i.e. in the Tune tab).
- Manually configure gains for the position loop.

The 1756-HYD02 module uses a single digital control loop with proportional, integral, differential and feed-forward gains. The parameters on this tab can be edited in two ways:

- Type parameter changes in the fields available on this tab and use the OK or Apply buttons to save your edits.

- Edit in the Manual Adjust dialog. To do so:

  a. Click on the Manual Tune button.

  b. Use the spin controls to edit parameter settings.

  Your changes are saved the moment a spin control changes any parameter value.

The parameters on this tab become read-only when the controller is online if the controller is set to Hard Run mode, or if a Feedback On condition exists.

When RSLogix 5000 is offline, the parameters described in Table 4.12 can be edited and the program saved to disk using either the Save command or by clicking on the Apply button. You must download the edited program to the controller before it can be run.

Table 4.12 lists the configurable features available on the Gains tab.

Table 4.12

Feature:	Definition:
Position Gains: Proportional	Position gain is used with position error to correct an axis' position. The proportional gain specifies the amount of correction (velocity command) that the controller applies for each unit of position error. You must determine how much position error is expected while an axis runs at a specific speed. To produce a component of the Velocity Command that ultimately attempts to correct for the position error, multiply the Position Gains:Proportional by the Position Error. • Too little Position Gains:Proportional results in excessively compliant, or mushy, axis behavior. • Too large a Position Gains:Proportional, on the other hand, can result in axis oscillation due to loop instability. To set the gain manually, you must first set the velocity output scaling factor in the Output tab of this dialog. If you know the desired position loop gain in inches per minute per mil or millimeters per minute per mil, use the following formula to calculate the corresponding P gain: Position Gains:Proportional = 16.667 * Desired Loop Gain (IPM/mil) If you know the desired gain bandwidth of the position loop in Hertz, use the following formula to calculate the corresponding P gain: Position Gains:Proportional = Bandwidth (Hertz) x 6.28 The typical value for the Position Gains:Proportional is ~100 Sec^{-1}.
Position Gains: Integral	The Integral (i.e., summation) of Position Error is multiplied by the Position Gains: Integral, or Pos I Gain, to produce a component to the Velocity Command that ultimately attempts to correct for the position error. Position Gains: Integral improves the steady-state positioning performance of the system. Increasing the integral gain generally increases the ultimate positioning accuracy of the system. Excessive integral gain, however, results in system instability. In certain cases, Position Gains: Integral control is disabled. One such case is when the analog output to the axis' drive is saturated. Continuing integral control behavior in this case would only exacerbate the situation. When the Integrator Hold parameter is set to Enabled, the axis loop automatically disables the integrator during commanded motion. The Position Gains: Integral is also disabled when the axis' actual position is within the deadband compensation window of the target position. This keeps the axis from hunting when valves with overlapped spools are used. While the Position Gains: Integral is typically established by the automatic axis loop tuning procedure (in the Tuning tab of this dialog), its value may also be set manually. Before doing this, the Velocity Scaling factor for the axis must be established for the drive system. Once this is done, the Position Gains: Integral can be computed based on the current or computed value for the Position Gains:Proportional using the following formula: Position Gains: Integral =.025 X 0.001 s/ms X $(\text{Position Gains:Proportional})^2$ Assuming a Position Gains:Proportional value of 100 Sec^{-1} this results in a Position Gains: Integral value of 0.25 1/ms-s

Table 4.12

Feature:	Definition:
Position Gains: Differential	Velocity Error is multiplied by the Position Gains: Differential to produce a component to the analog output or Velocity Command that ultimately attempts to correct for the velocity error, creating a damping effect. Thus, increasing the Position Gains: Differential results in smoother motion, enhanced acceleration, reduced overshoot, and greater system stability. However, too much Position Gains: Differential leads to high frequency instability and resonance effects.
Feedforward Gains: Velocity	Feedforward Gains: Velocity scales the current Command Velocity by the Feedforward Gains: Velocity and adds it as an offset. Hence, the Feedforward Gains: Velocity allows the following error of the hydraulic closed loop system to be reduced to nearly zero when running at a constant speed. This is important in applications such as electronic gearing, position camming, and synchronization applications, where it is necessary that the actual axis position not significantly lag behind the commanded position at any time. The optimal value for Feedforward Gains: Velocity is 100%. However, you may need to adjust the value to accommodate axes with non-linear characteristics and other application considerations.
Feedforward Gains: Acceleration	Feedforward Gains: Acceleration scales the current Command Acceleration by the Feedforward Gains: Acceleration and adds it as an offset to the analog output generated by the position loop. With this done, the position loops do not need to generate much of a contribution to the analog output, hence the Position and/or Velocity Error values are significantly reduced. When used in conjunction with the Feedforward Gains: Velocity, the Feedforward Gains: Acceleration allows the following error of the hydraulic closed loop system during the acceleration and deceleration phases of motion to be reduced to nearly zero. This is important in applications such as electronic gearing, position camming, and synchronization applications, where it is necessary that the actual axis position not significantly lag behind the commanded position at any time. Remember, however, because the output is scaled in velocity, the Feedforward Gains:Acceleration calibration is application-dependent.
Integrator Hold	The integrator is always enabled. With this setting, the position loop temporarily disables the integrators while the command position is changing. Point-to-point moves use this feature to minimize the integrator wind-up during motion.
Manual Tune	This button accesses the Gains tab of the Manual Tune dialog for online editing. The Manual Tune button is disabled when RSLogix 5000 is in Wizard mode, and when you have not yet saved or applied your offline edits to the other parameters in this table.

Output Tab

Use the Output tab for offline configuration of the following:

- Scaling values that are used to generate gains.
- The analog loop's low-pass digital output filter.

The parameters on this tab can be edited in two ways:

- Type parameter changes in the fields available on this tab and use the OK or Apply buttons to save your edits.

- Edit in the Manual Adjust dialog. To do so:
  a. Click on the Manual Tune button.
  b. Use the spin controls to edit parameter settings.

  Your changes are saved the moment a spin control changes any parameter value.

The parameters on this tab become read-only when the controller is online if the controller is set to Hard Run mode, or if a Feedback On condition exists.

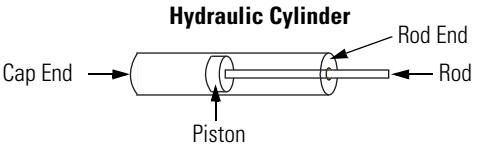
When RSLogix 5000 is offline, the following parameters can be edited and the program saved to disk using either the Save command or by clicking on the Apply button. You must download the edited program to the controller before it can be run.

Table 4.13 lists the configurable features available on the Output tab.

Table 4.13

Feature:	Definition:
Velocity Scaling	Converts the output of the position loop into equivalent voltage to an external hydraulic axis. This conversion "normalizes" the units of the position loop gain parameters so that variations in feedback resolution, drive scaling, or mechanical gear ratios do not affect their values. The automatic loop tuning procedures typically establish the Velocity Scaling value, but these values can be calculated, if necessary, using the following guidelines. Velocity Scaling = 100% / (Speed @ 100%) For example, if this axis is using position units of inches, and the hydraulic system is designed such that with an input of 100% (e.g. 10 Volts) the axis goes 55.6 inches per second, the Velocity Scaling attribute value would be calculated as: Velocity Scaling = 100% / (55.6) = 1.8% / Inches Per Second

Table 4.13

Feature:	Definition:
Direction Scaling Ratio	The directional scaling ratio compensates for the difference in the maximum speed in the extend vs. retract direction on single-ended hydraulic cylinders. Different piston areas on the cap (blind) end compared to the rod end of the cylinder cause the speed difference.  Cap End Area = $[(\text{Cylinder Radius})^2 \times (\text{pi})]$ Rod End Area = $[(\text{Cylinder Radius})^2 \times (\text{pi})] - [(\text{Rod Radius})^2 \times (\text{pi})]$ Depending on your Feedback Polarity Setting Directional Scaling Ratio = $\sqrt{\frac{\text{Cap End Area}}{\text{Rod End Area}}}$ or Directional Scaling Ratio = $\sqrt{\frac{\text{Rod End Area}}{\text{Cap End Area}}}$ To find this value, you can run the auto-tune routine in both directions and find the ratio of the velocity scaling in the two directions.
Enable Low-pass Output Filter	Enables the axis loop's low-pass digital output filter. During tuning, if the controller detects a high degree of tuning inertia, it enables the Low Pass Output Filter and calculates and sets a value for Low Pass Output Filter Bandwidth.
Low-pass Output Filter Bandwidth	This Hertz bandwidth value filters out high frequency variation of the hydraulic module output to the drive. All output from the hydraulic module greater than the Filter Bandwidth setting will be filtered-out, and not sent to the drive. If the Low-pass Output Filter Bandwidth value is set to zero, the low-pass output filter is disabled. The lower the Filter Bandwidth value, the greater the attenuation of these high frequency components of the output signal. Because the low-pass filter adds lag to the position loop, which pushes the system towards instability, decreasing the Filter Bandwidth value usually requires lowering the Position or Velocity Proportional Gain settings to maintain stability. The output filter is particularly useful in high inertia applications where resonance behavior can severely restrict the maximum bandwidth capability of the position loop.
Manual Adjust	Click on this button to access the Output tab of the Manual Tune dialog for online editing. The Manual Tune button is disabled when RSLogix 5000 is in Wizard mode, and when you have not yet saved or applied your offline edits to the above parameters.

Limits Tab

Use the Limits tab to set the following parameters offline:

- Enable positive and negative software travel limits
- Set maximum positive and negative software travel limits
- Configure Position Error Tolerance
- Configure Position Lock Tolerance
- Set the module's Output Limit

The parameters on this tab can be edited in two ways:

- Type parameter changes in the fields available on this tab and use the OK or Apply buttons to save your edits.

- Edit in the Manual Adjust dialog. To do so:
  a. Click on the Manual Tune button.
  b. Use the increase/decrease arrows to edit parameter settings.

  Your changes are saved the moment increase/decrease arrows change any parameter value.

The parameters on this tab become read-only when the controller is online if the controller is set to Hard Run mode, or if a Feedback On condition exists.

When RSLogix 5000 is offline, the following parameters can be edited and the program saved to disk using either the Save command or by clicking on the Apply button. You must download the edited program to the controller before it can be run.

Table 4.14 lists the configurable features available on the Limits tab.

Table 4.14

Feature:	Definition:
Soft Travel Limits	Enables software overtravel checking for an axis when Positioning Mode is set to Linear (on the Conversion tab). If an axis is configured for software overtravel limits, and if that axis passes beyond these maximum travel limits (positive or negative), a software overtravel fault is issued. The response to this fault is specified by the Soft Overtravel setting (on the Fault Actions tab). Software overtravel limits are disabled during the tuning process. When Soft Travel Limits are enabled, the travel limits are active even if the axis has not been honed or before an absolute home position has been established. Under this condition, maximum positive and maximum negative travel limit positions are not necessarily related to user-defined references.
Soft Travel Limits:Maximum Positive	Type the maximum positive position to be used for software overtravel checking, in position units. The Maximum Positive limit must be greater than the Maximum Negative limit.

Table 4.14

Feature:	Definition:
Soft Travel Limits:Maximum Negative	Type the maximum negative position to be used for software overtravel checking, in position units. The Maximum Negative limit must be less than the Maximum Positive limit.
Position Error Tolerance	Specifies how much position error the axis loop tolerates before issuing a position error fault. This value is interpreted as a +/- quantity. For example, setting Position Error Tolerance to 0.75 position units means that a position error fault will be generated whenever the position error of the axis is greater than 0.75 or less than -0.75 position units. This value is set to twice the following error at maximum speed based on the measured response of the axis, during the autotuning process. In most applications, this value provides reasonable protection in case of an axis fault or stall condition without nuisance faults during normal operation. If you need to change the calculated position error tolerance value, the recommended setting is 120% to 150% of the position error while the axis is running at its maximum speed.
Position Lock Tolerance	Specifies the maximum position error the hydraulic module accepts to indicate the Position Lock status bit is set. This is useful in determining when the desired end position is reached for position moves. This value is interpreted as a +/- quantity. For example, specifying a lock tolerance of 0.01 provides a minimum positioning accuracy of +/- 0.01 position units.
Output Limit	Provides a method of limiting the maximum analog output voltage of a physical axis to a specified level. The analog output for the axis as a function of position loop error, both with and without analog output limiting. The analog output limit may be used if the valve cannot accept the full +/-10V range of the analog output. In this case, the analog output limit value effectively limits the maximum command sent to the valve. For example, if the valve can only accept command signals up to +/-7.5V, set the analog output limit value to 7.5V.
Manual Adjust	This button accesses the Limits tab of the Manual Tune dialog for online editing. The Manual Tune button is disabled when RSLogix 5000 is in Wizard mode, and when you have not yet saved or applied your offline edits to the above parameters.

Offset Tab

Use the Offset tab to make offline adjustments to the following values:

- Deadband Compensation
- Velocity Offset
- Output Offset

The parameters on this tab can be edited in two ways:

- Type parameter changes in the fields available on this tab and use the OK or Apply buttons to save your edits.

- Edit in the Manual Adjust dialog. To do so:

  a. Click on the Manual Tune button.

  b. Use the spin controls to edit parameter settings.

  Your changes are saved the moment a spin control changes any parameter value.

The parameters on this tab become read-only when the controller is online if the controller is set to Hard Run mode, or if a Feedback On condition exists.

When RSLogix 5000 is offline, the following parameters can be edited and the program saved to disk using either the Save command or by clicking on the Apply button. You must download the edited program to the controller before it can be run.

Table 4.15 lists the configurable features available on the Offset tab.

Table 4.15

Feature:	Definition:
Friction/Deadband Compensation: Friction Compensation	The percentage of output level added to the current positive value, or subtracted from the current negative value, for the purpose of moving an axis that is stuck in place due to static friction. The default value of this parameter is 0%. It is not unusual for an axis to have enough static friction–called "sticktion"–that, even with a significant position error, the axis refuses to budge. Friction Compensation is used to break "sticktion" in the presence of a non-zero position error. The Friction Compensation value should be slightly less than the value that would break the "sticktion". A larger value will cause the axis to "dither" (i.e. move rapidly back and forth about the commanded position). This value is not applicable for Ultra3000 drives.

Table 4.15

Feature:	Definition:
Friction/Deadband Compensation: Window	This window is defined as: command position - window attribute to command position + window attribute While the command velocity is zero and the actual position is within this window, the Friction Compensation (or Deadband Compensation, for Hydraulics) is applied proportionally to the position error. While the command velocity is non-zero, the full Friction Compensation is applied.
Backlash Compensation: Reversal Offset	Use this feature to compensate for positional inaccuracy introduced by mechanical backlash. For example, power-train type applications require a high level of accuracy and repeatability during machining operations. Lost motion is often generated by a number of mechanical components that may introduce inaccuracies and that are subject to wear over their lifetime. Hence, when an axis is commanded to reverse direction, mechanical lost motion in the machine may result in a small amount of actuator motion without axis motion. As a result, the feedback device may indicate movement even though the axis has not physically moved. The Reversal Offset specifies a directional offset that is added to the motion planner's command position as it is applied to the associated axis loop to compensate for mechanical lost motion. When the commanded velocity changes sign (a reversal), the ControlLogix controller adds, or subtracts, the Reversal Offset value from the current commanded position; the axis immediately moves the motor to the other side of the lost motion window and engages the load. The application of this directional offset is completely transparent and does not affect the value of the Command Position attribute. If a value of zero is applied to the Reversal Offset, the feature is effectively disabled. Once enabled by a non-zero value, and the load is engaged by a reversal of the commanded motion, changing the Reversal Offset can cause the axis to shift as the offset correction is applied to the command position.
Backlash Compensation: Stabilization Window	Eliminates backlash-induced instability while maintaining full system bandwidth. This algorithm value should be commensurate with the amount of backlash in the mechanical system. Mechanical backlash is a common problem in applications that use mechanical gearboxes. Until the input gear is turned to the point where its proximal tooth contacts an adjacent tooth of the output gear, the reflected inertia of the output is not felt at the actuator (i.e. when the gear teeth are not engaged, the system inertia is reduced to the motor inertia). If the axis loop is tuned for peak performance with the load applied, the axis will be at best under-damped and at worst unstable in the condition where the gear teeth are not engaged. In the worst case scenario, the motor axis and the input gear oscillates wildly between the limits imposed by the output gear teeth. The net effect is a loud buzzing sound when the axis is at rest. If this situation persists the gearbox will wear out prematurely. To prevent this condition, the conventional approach is to de-tune the loop so that the axis is stable without the gearbox load applied. Unfortunately, system performance suffers. The key to this algorithm is a tapered Torque Scaling profile, that is a function of the position error of the axis loop. The reason for the tapered profile, as opposed to a step profile, is that when the position error exceeds the backlash distance a step profile would create a very large discontinuity in the torque output. This repulsing torque tends to slam the axis back against the opposite gear tooth and perpetuate the buzzing effect. The tapered profile is only run when the acceleration command to the axis loop is zero, i.e. when we are not commanding any acceleration or deceleration that would engage the teeth of the gearbox. Properly configured with a suitable value for the Backlash Stabilization Window, this algorithm entirely eliminates the gearbox buzz without sacrificing any axis performance. The Backlash Stabilization parameter determines the width of the window over which backlash stabilization is applied. In general, this value should be set to the measured backlash distance. A Backlash Stabilization Window value of zero effectively disables the feature. (Patent Pending)
Velocity Offset	Provides a dynamic velocity correction to the output of the position loop, in position units per second. Because the position loop output value is updated synchronously every Coarse Update Period, the Velocity Offset can be tied into custom outer control loop algorithms using Function Block programming. Position loop is still closed and compensates for velocity offset values by changing position error. Position error faults are possible.

Table 4.15

Feature:	Definition:
Output Offset	Corrects the problem of axis "offset", by adding a fixed voltage value (not to exceed +/-10V) to the analog output value. Use a value to achieve near zero axis velocity when the uncompensated analog output value is zero. When interfacing to a valve on a hydraulic axis, it is necessary to compensate for the effect of drive offset. Cumulative offsets of the hydraulic module's DAC output and the Axis Input result in a situation where a zero commanded analog output value causes the axis to "drift". If the drift is excessive, it can play havoc on the Hookup Diagnostic and Tuning procedures, as well as result in a steady-state non-zero position error when the axis loop is closed.
Manual Adjust	Click on this button to access the Offset tab of the Manual Tune dialog for online editing. The Manual Tune button is disabled when RSLogix 5000 is in Wizard mode, and when you have not yet saved or applied your offline edits to the above parameters.

Fault Actions Tab

You must set the action if any of the faults listed in Table 4.16 occurs. The possible options are:

- Shutdown
- Disable Drive
- Stop Motion
- Status Only - When this option is chosen for any fault condition, the fault does not cause the axis to stop its current motion. However, new motion is prevented from starting.

Table 4.16 lists the faults that may occur:

Table 4.16

Fault Type:	Definition:
Drive Fault	Specifies the fault action to be taken when a drive fault condition is detected, for an axis with the Drive Fault Input enabled (in the Servo tab of this dialog) that is configured as Servo (in the General tab of this dialog).
Feedback Noise	Specifies the fault action to be taken when excessive feedback noise is detected.
Feedback	Specifies the fault action to be taken when feedback loss condition is detected. **ATTENTION**: If a feedback fault occurs, the 1756-HYD02 module cannot control the axis. We recommend you use either the shutdown or disable drive option for this setting. If used, the stop motion and status only options may cause dangerous conditions when a feedback fault occurs.
Position Error	Specifies the fault action to be taken when position error exceeds the position tolerance set for the axis, for an axis configured as Servo (on the General tab).
Soft Overtravel	Specifies the fault action to be taken when a software overtravel error occurs, for an axis with Soft Travel Limits enabled and configured (on the Limits tab) that is configured as Servo (on the General tab).

Table 4.17 describes the possible actions if any of the faults listed in Table 4.16 occurs

Table 4.17

Fault:	Definition:
Shutdown	If a fault action is set to Shutdown, when the associated fault occurs: • servo action status is immediately disabled, • the drive output is zeroed, and • the appropriate drive enable output is deactivated. Furthermore, this fault action opens the OK contact associated with the hydraulic module that can be used to open the E-stop string to the hydraulic power unit. Shutdown is the most severe action to a fault and it is usually reserved for faults that could endanger the machine or the operator if power is not removed as quickly and completely as possible.
Disable Drive	If a fault action is set to Disable Drive, when the associated fault occurs: • servo action status is immediately disabled, • the drive output is zeroed, and • the appropriate drive enable output is deactivated.
Stop a Motion	If a fault action is set to Stop Motion, when the associated fault occurs, the axis immediately starts decelerating the axis command position to a stop at the configured Maximum Deceleration Rate without disabling servo action status or the hydraulic modules Drive Enable output. This is the gentlest stopping mechanism in response to a fault. It is usually used for less severe faults. After the stop command fault action has stopped the axis, no further motion can be generated until the fault is first cleared.
Status Only	If a fault action is set to Status Only, when the associated fault occurs, no action is taken. The application program must handle any motion faults. In general, this setting should only be used in applications where the standard fault actions are not appropriate. **ATTENTION**: Selecting the wrong fault action for your application can cause a dangerous condition. Keep clear of moving machinery.

Tag Tab

Use this tab to change the name and description of the axis. When you are online, all of the parameters on this tab transition to a read-only state, and cannot be modified. If you go online before you save your changes, all pending changes revert to their previously-saved state.

Table 4.18 lists the features available on the Tag tab. Some of these features cannot be changed on this screen however.

Table 4.18

Fault Type:	Definition:
Name	Displays the name of the current tag.
Description	Displays the description of the current tag, if any is available.
Tag Type	Indicates the current tag type. • Base • Alias • Consumed
Data Type	Displays the data type associated with the current tag.
Scope	Displays the scope of the current tag. For axis tags, the scope must be controller scope.
Style	Displays the default style in which to display the value of the tag. Note that style is only applicable to an atomic tag; a structure tag does not have a display style.

Chapter Summary and What's Next

In this chapter, you read about the 1756-HYD02 module's features.

Chapter 5 describes Troubleshooting the 1756-HYD02 Module.

Troubleshooting the 1756-HYD02 Module

What This Chapter Contains

This chapter describes how to troubleshoot the 1756-HYD02 module.

For more information about:	See page:
Using the Status Indicators	5-1
Using the OK Indicator	5-2
Using the FDBK Indicator	5-3
Using the DRIVE Indicator	5-4
Using RSLogix 5000 to Troubleshoot the Module	5-5

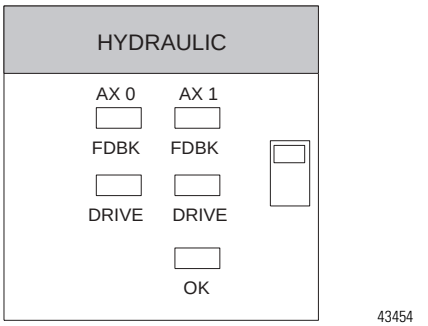
Using the Status Indicators

The ControlLogix Hydraulic Servo module uses a single bi-colored LED to indicate module OK status and bi-colored LED indicators to show individual feedback (FDBK) and drive (DRIVE) status for both axes.

During power-up, the module completes an indicator test. The OK indicator turns red for 1 second and then turns to flashing green if the module passes all its self tests.

The module's status indicators are shown in Figure 5.1.

Figure 5.1



Using the OK Indicator

The module's OK indicator is shown in Figure 5.2.

Figure 5.2

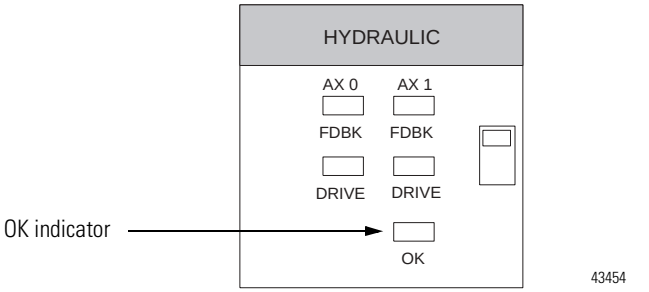


Table 5.1 explains the OK indicator.

Table 5.1 OK Indicator Displays

If the OK indicator displays:	The module status is:	Take this action:
Off	The module is not operating.	• Apply chassis power. • Verify the module is completely inserted into the chassis and backplane.
Flashing green light	The module has passed internal diagnostics, but it is not communicating axis data over the backplane.	• Configure the module to begin communications. • If you have configured the module, check the slot number in the 1756-HYD02 Properties dialog box.
Steady green light	One of the following: • Axis data is being exchanged with the module. • The module is in the normal operating state.	None
Flashing red light	One of the following: • A major recoverable failure has occurred. • A communication fault, timer fault, or NVS update is in progress. • The OK contact has opened.	If a Non-Volatile Storage (NVS) update is in progress, complete the NVS update. If an NVS update is not in progress, follow these steps: 1. Check the Servo Fault word for the source of the error. 2. Clear the servo fault condition using the Motion Axis Fault Reset instruction. 3. Resume normal operation. 4. If the flashing persists, reconfigure the module.
Steady red light	One of the following: • A potential non- recoverable fault has occurred. • The OK contact has opened.	Follow these steps: 1. Reboot the module. 2. If the solid red persists, replace the module.

Using the FDBK Indicator

The module's FDBK indicators are shown in Figure 5.3. Make sure that any transducer used with the 1756-HYD02 module uses an external interrogation signal.

Figure 5.3

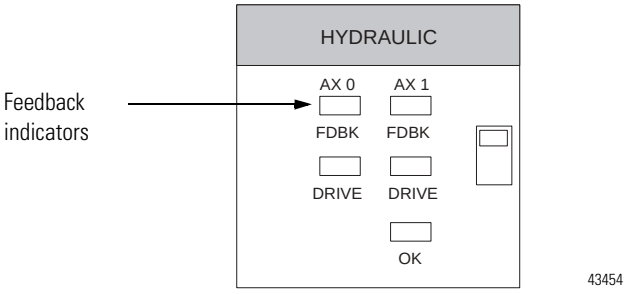


Table 5.2 explains the FDBK indicators.

Table 5.2 FDBK Indicator Displays

If the FDBK indicator displays:	The module status is:	Take this action:
Off	The axis is not used.	If you are using this axis, make sure the module is configured and an axis tag has been associated with the module.
Flashing green light	The axis is in the normal servo loop inactive state.	None. The servo axis state can be changed by executing motion instructions.
Steady green light	The axis is in the normal servo loop active state.	None. The servo can may be changed by executing motion instructions.
Flashing red light	The axis servo loop error tolerance has been exceeded.	Follow these steps: 1. Correct the source of the problem. 2. Clear the servo fault condition using the Motion Axis Fault Reset instruction. 3. Resume normal operation.
Steady red light	An axis LDT feedback fault has occurred.	Follow these steps: 1. Correct the source of the problem by checking the LDT and power connections. 2. Clear the servo fault condition using the Motion Axis Fault Reset instruction. 3. Resume normal operation.

Using the DRIVE Indicator

The module's DRIVE indicators are shown in Figure 5.4.

Figure 5.4

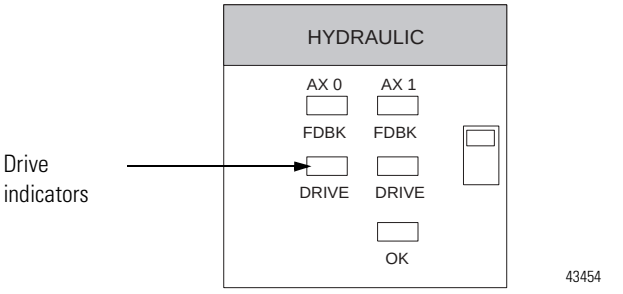


Table 5.3 explains the DRIVE indicator.

Table 5.3 DRIVE Indicator Displays

If the DRIVE indicator displays:	The module status is:	Take this action:
Off	One of the following: • The axis is not used. • The axis is a position-only axis type.	If the axis is being used and is not a position-only axis type, make sure the module is configured, an axis tag has been associated with the module, and the axis type is servo.
Flashing green light	The axis drive is in the normal disabled state.	None. The servo axis state can be changed by executing motion instructions.
Steady green light	The axis drive is in the normal enabled state.	None. The servo axis state can be changed by executing motion instructions.
Flashing red light	The axis drive output is in the shutdown state.	Follow these steps: 1. Check for faults that may have generated this state. 2. Execute the Shutdown Reset motion instruction. 3. Resume normal operation.
Steady red light	The axis drive is faulted.	Follow these steps: 1. Check the drive status. 2. Clear the Drive Fault condition at the drive. 3. Clear the servo fault condition using the Motion Axis Fault Reset instruction. 4. Resume normal operation. 5. Check the configuration for the Drive Fault. • If configured to be normally open and there is no voltage, this is the normal condition. • If configured to be normally closed and 24V is applied, this is the normal condition.

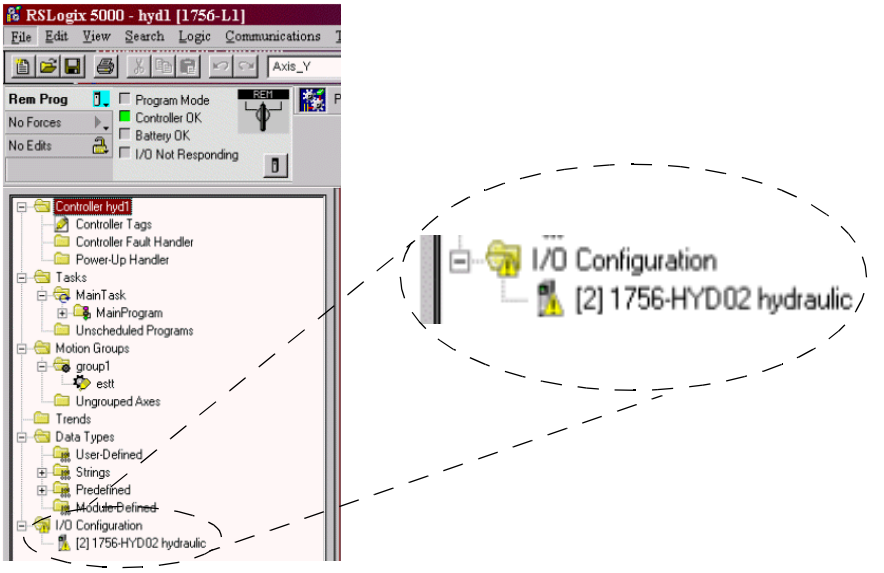
Using RSLogix 5000 to Troubleshoot the Module

You can also use the RSLogix 5000 programming software to detect and diagnose problems with the ControlLogix Hydraulic Servo module. The software alerts you to fault and other conditions in the following ways:

- Warning Signal in Controller Organizer
- Fault Message in Status Line
- Notification in Axis Structure

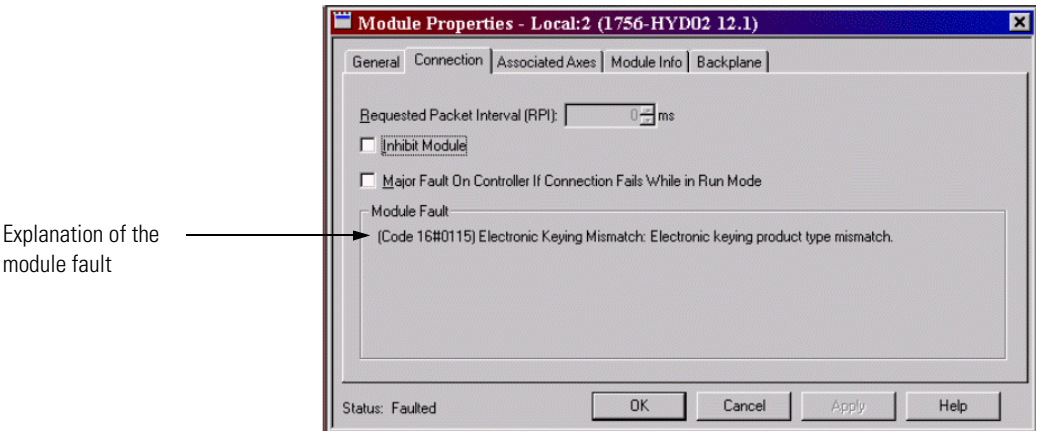
Warning Signal in Controller Organizer

The warning signal appears in the module listing as shown below.



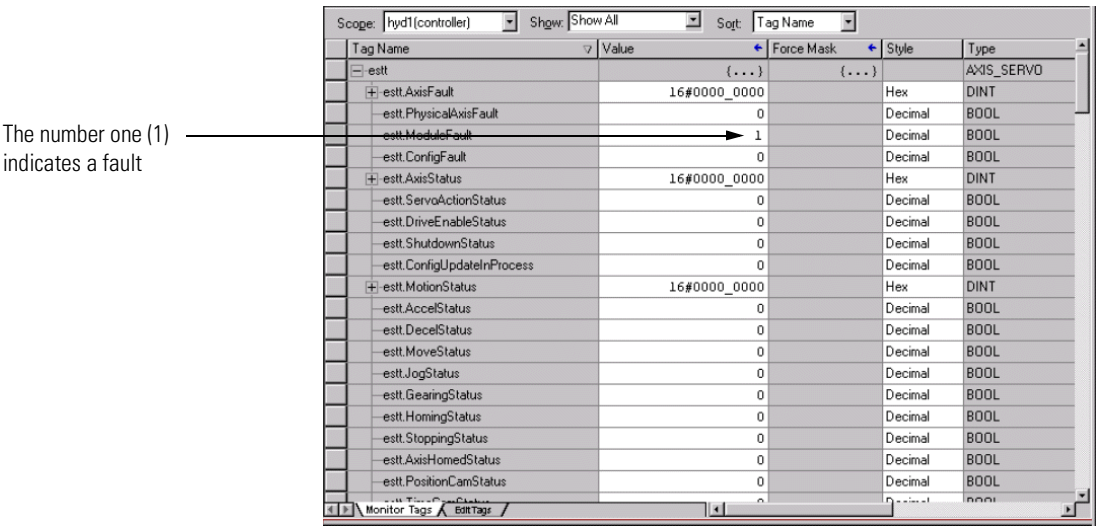
Fault Message in Status Line

The module status line appears in the lower left corner of each configuration tab. It provides a brief explanation of the module status and reports Faulted when a fault has occurred on the module.



Notification in Axis Structure

Use the Tag Monitor to view controller tags. A fault has occurred for any point that lists the number one (1) in the Fault line.



Chapter Summary and What's Next

In this chapter, you read about Troubleshooting the 1756-HYD02 Module. Appendix A lists the module Specifications.

Specifications

Number of axes	2 axes maximum
Servo loop	
Type	Proportional, integral and differential (PID) with Feed-Forwards and Directional scaling
Gain resolution	32- bit floating point
Absolute position range	230,000 LDT counts
Rate	500Hz to 4kHz (Selectable)
Module location	1756 ControlLogix chassis
Module keying	Electronic
Power dissipation	5.5W maximum
Thermal dissipation	18.77 BTU/hr.
Backplane current	5.1V dc @ 700mA and 24V dc @ 2.5mA
LDT input	
Type	PWM, Start/Stop rising or falling edge
Sample rate	120MHz (8.33ns)
Resolution[1]	Less than 0.001 inch with single recirculation
Electrical interface	Isolated 5V differential (RS-422 signal)
Input impedance	215 Ohm differential
Output load	100 Ohm minimum
Registration inputs	
Type	Optically isolated, current sinking input
24V dc input voltage	+24V dc nominal
Maximum on	26. 4V dc
Minimum on	18. 5V dc
Maximum off	3.5V dc
5V dc input voltage	+5V dc nominal
Maximum on	5.5V dc
Minimum on	3.7V dc
Maximum off	1.5V dc
Input impedance	
24V dc input	1.2 kΩ
5V dc input	9.5 kΩ
Response time (position latched)	1 servo update period - Servo update period is the period at which the position and/or velocity feedback is sampled and a new servo loop is closed to generate a new servo output. The time of this period is a user-defined setting from 250µs to 2000µs.
All other inputs	
Type	Optically isolated, current sinking input
Input voltage	+24V dc nominal
Maximum on	26. 4V dc
Minimum on	17. 0V dc
Maximum off	8.5V dc
Input impedance	7.5 kΩ

Servo output	
Type	Analog voltage
Voltage range	±10V dc
Voltage resolution	16 bits
Load	5.6 kOhms resistive minimum
Maximum offset	25 mV
Gain error	±4%
All other outputs	
Type	Solid-state isolated relay contacts
Operating voltage	+24V dc nominal
Maximum	26. 4V dc
Operating current	75 mA
Isolation Voltage	
User to System	30V continuous
RTB keying	User-defined
Field wiring arm	36-position RTB (1756-TBCH or -TBS6H)(2)
RTB screw torque (cage clamp)	4.4 inch-pounds (0.4Nm) maximum
Conductors	
Wire size	#22 to #14 AWG (0.324 to 2.08 sq. mm) stranded(1) 3/ 64 inch (1.2 mm) insulation maximum
Category	2(3), (4)
Screwdriver blade width for RTB	1/8 inch (3.2mm) maximum
Environmental Conditions	
Operating Temperature	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): 0 to 60°C (32 to 140°F)
Storage Temperature	IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold), IEC 60068-2-2 (Test Bb, Un-packaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock): –40 to 85°C (–40 to 185°F)
Relative Humidity	IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat): 5 to 95% non-condensing
Vibration	IEC60068-2-6 (Test Fc, Operating): 2g @ 10-500Hz
Shock	IEC60068-2-27 (Test Ea, Unpackaged shock): Operating 30g Non-operating 50g
Emissions	CISPR 11: Group 1, Class A
ESD Immunity	IEC 61000-4-2: 6kV contact discharges 8kV air discharges

Radiated RF Immunity	IEC 61000-4-3: 10V/m with 1kHz sine-wave 80%AM from 80MHz to 2000MHz 10V/m with 200Hz 50% Pulse 100%AM at 900Mhz
EFT/B Immunity	IEC 61000-4-4: ±2kV at 5kHz on signal ports
Surge Transient Immunity	IEC 61000-4-5: ±2kV line-earth (CM) on shielded ports
Conducted RF Immunity	IEC 61000-4-6: 10Vrms with 1kHz sine-wave 80%AM from 150kHz to 80MHz
Enclosure Type Rating	None (open-style)
Certifications (when product is marked)	UL UL Listed Industrial Control Equipment CSA CSA Certified Process Control Equipment CSA CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations CE[5] European Union 89/336/EEC EMC Directive, compliant with: EN 50082-2; Industrial Immunity EN 61326; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions C-Tick[4] Australian Radiocommunications Act, compliant with: AS/NZS 2064; Industrial Emissions

(1) This specification represents the maximum LTD input resolution that the 1756-HYD02 module can accept. The module does not require that you connect an LDT with this level of resolution.

(2) Maximum wire size requires the extended-depth RTB housing (1756-TBE).

(3) Use the conductor category information for planning conductor routing as described in the system level installation manual.

(4) Refer to Industrial Automation Wiring and Grounding Guidelines, publication number 1770-4.1.

(5) See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Notes:

Broadcast

Data transmissions to all address or functions

Bumpless reconfiguration

A reconfiguration in which the real time data connection to the module is not closed and reopened. Communications are never interrupted and configuration data is applied to the module immediately. This works best in a single owner-controller system.

Compatible match

An electronic keying protection mode that requires that the physical module and the module configured in the software to match according to vendor and catalog number. In this case, the minor revision of the module must greater than or equal to that of the configured slot.

Connection

The communication mechanism from the controller to another module in the control system.

ControlBus™

The backplane used by the 1756 chassis.

ControlLogix chassis

Hardware assembly that houses devices such as ControlLogix Hydraulic Servo modules, ControlLogix controllers and power supplies.

ControlLogix controller

Controller used in the ControlLogix system that uses programmable memory for storage of data to implement specific functions such as I/O control, logic, timing and data file manipulation. The ControlLogix controller owns and communicates with the ControlLogix Hydraulic Servo module to control hydraulic applications.

ControlLogix power supply

An electrical circuit that filters, conditions and supplies appropriate voltages for system components and circuitry.

Disable keying

An electronic keying protection mode that requires no attributes of the physical module and the module configured in the software to match

Download

The process of transferring the contents of a project on the workstation into the controller

Electronic keying

A feature where modules can be requested to perform an electronic check to make sure that the physical module is consistent with what was configured by the software

Exact match

An electronic keying protection mode that requires the physical module and the module configured in the software to match according to vendor, catalog number, major revision and minor revision

Field side

Interface between user field wiring and I/O module

Inhibit

A ControlLogix process that allows you to configure the Hydraulic Servo module but prevent it from communicating with the owner-controller. In this case, the controller behaves as if the module does not exist at all

Interface module (IFM)

A module that uses prewired cable to connect wiring to an I/O module

Linear displacement transducer (LDT)

Feedback device connected to the ControlLogix Hydraulic Servo module that provides axis position data. Any LDT used with the ControlLogix Hydraulic Servo module should use an external interrogation signal.

Major revision

A module revision that is updated any time there is a functional change to the module

Minor revision

A module revision that is updated any time there is a change to the module that does not affect its function or interface

Owner-controller

The controller that creates and stores the primary configuration and communication connection to a module

Position loop

Part of motion control firmware responsible for:

- comparing measured position with command position to determine a position error

  and

- generating a signal to an actuator to reduce any position error that may occur.

Program Mode

In this mode the following events occur:

- Controller program is not executing.
- Inputs are still actively producing data.
- Outputs are not actively controlled and go to their configured program mode

Removal and insertion under power (RIUP)

ControlLogix feature that allows a user to install or remove a module or RTB while power is applied

Removable Terminal Block (RTB)

Field wiring connector for I/O modules

RSLogix 5000

Programming software used to configure and troubleshoot the ControlLogix Hydraulic Servo module.

Run mode

In this mode, the following events occur:

- Controller program is executing
- Inputs are actively producing data.
- Outputs are actively controlled

Service

A system feature that is performed on user demand, such as fuse reset or diagnostic latch reset

Status indicators

Indicators on the front of the ControlLogix Hydraulic Servo module that display the general status of the module and specific status of individual feedback and drive conditions for the axes connected to the module.

System side

Backplane side of the interface to the I/O module

Tag

A named area of the controller's memory where data is stored

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